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Bangladesh Agricultural University, Mymensingh, Bangladesh

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FOREWORD

Bangladesh Agricultural University Research System (BAURES) is coordinating, organizing and monitoring all non-degree-oriented research programmes undertaken by the teachers of this university. At present, 602 projects are being carried out by the teachers and researchers in different disciplines of agricultural sciences. The annual review workshop is a regular process to present, discuss and evaluate the progress of research carried out in the preceding year. I am very happy to know that the publication of the 34 volume of the Bangladesh Agricultural University Research Progress is in the form of proceedings of the workshop held on 27 & 28 April 2024. This volume contains 450 abstracts of on-going/completed research projects conducted in the fiscal year 2022–2023. I am confident that the research findings documented in this report would be very helpful to the researchers working in the field of agricultural sciences.

I am taking the opportunity to congratulate the Principal Investigators/Project Directors and all other investigators/researchers of different research projects for presenting their research findings to make the workshop a success. My heartfelt thanks are due to the Associate Director, BAURES, Dr. Paresh Kumar Sharma and Mr. Abul Hashem, Deputy Director, BAURES.

Special appreciation and thanks are expressed to the national and international donor agencies for funding and implementing the research projects under BAURES. Finally, the encouragement and support extended by the honorable Vice-Chancellor of BAU are gratefully acknowledged.

Professor Dr. Mahfuza Begum
Chief Editor
&
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EDITORIAL NOTE

Bangladesh Agricultural University Research System (BAURES) is responsible for providing necessary support for the overall administration, monitoring and implementation of research projects conducted by the teachers and researchers from different faculties of Bangladesh Agricultural University (BAU), Mymensingh. BAU itself provides grants for research projects which have been increased by volume and number in recent years. Through administrative and legal support, BAURES has attracted many national and international donor agencies to provide research grants to the researchers of BAU which is steadily increasing. The findings of these research projects are presented in the annual workshop which is held every year, and the progress of the projects are evaluated as part of the monitoring and evaluation process by BAURES. This Volume of the proceeding includes abstracts of 602 research projects presented in the workshop held on 27 & 28 April 2024, where 302 projects were funded by BAU, and the remaining were funded by the domestic and international donor agencies.

The aim of publishing this proceeding is to provide information generated through project-based research by the teachers, researchers and extension workers engaged in agricultural research and development. This proceeding is edited by an editorial board consisting of intellectual expert members from six different Faculties of BAU. We have tried our best for quality publication of the proceeding. However, suggestions are always highly appreciated by BAURES regarding the improvement of the publication in the coming days and our best efforts will continue to improve the standard of future proceedings.

I would like to extend my sincere thanks and appreciation to the contributors and the learned members of the editorial board for their sincere cooperation and help in preparing, improving and proofreading the abstracts. I would also like to acknowledge and appreciate the valuable inputs of Prof. Dr. Mahfuza Begum, Director; Dr. Paresh Kumar Sarma, Senior Scientific Officer (SG), Mr. Md. Abul Hashem, Deputy Director and Mr. Md. Nazrul Islam, Computer Operator; BAURES in publishing this proceeding.

I wish you all the succes.

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&
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CHAPTER I

Faculty of Veterinary Science

BAU Res. Prog. 34, 2024

Effects of Non-nutritive Sweeteners on the Blood Profile and Vital Organs of Diabetic Mice

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Abstract
Diabetes mellitus (DM), is a group of metabolic disorders characterized by high blood sugar and if not treated properly diabetes can cause adverse disease leading to death. In order to reduce blood sugar, non-nutritive sweeteners or artificial sweeteners like aspartame, sucralose, saccharin, acesulfame potassium (AceK), and sodium cyclamate of in different brand names have been using which have adverse pathological effects. Therefore, this project has been designed to study the effects of aspartame, sucralose, saccharin, acesulfame potassium (AceK), and sodium cyclamate on the brain, liver, heart, kidney, and pancreas of artificially induced diabetic mice in comparison to the control. Our results showed that the average weight of the mice in between male and female varied. The male weight ranges from 30 g - 39 g and that of female 24 - 31 g. The random sugar of the control mice also varied in between male and female being higher in male. Different blood parameters also varied between male and female mice where most of the parameters were higher in female; NRBC, lymphocytes, neutrophils, eosinophils, and basophils are high in some groups while total WBC and PLT is low in most of the groups. The serum analysis revealed higher ranges of total bilirubin (TB), total bile acid (TBA), creatinine and glucose. In contrast, low level of amylase and phosphorus found in the treated diabetic mice in comparison to the control. Histological structures of the brain, heart, liver, pancreas and kidney of the control mice showed normal architectures, however, noticeable changes were recorded in the brain and pancreatic tissues. These results suggest some adverse effects of artificial sweeteners in mice. However, further study is required to explore the deep insights of pathobiology of artificial sweeteners.

Embalming: an Innovative and Cost-effective Technique for Fixation and Preservation of Carcasses in Bangladesh

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Abstract
The term embalming is the art and science of preserving the body of an animal after death with the use of certain chemicals. During the Renaissance period of Europe embalming techniques were primarily used to preserve the cadavers for dissection and study purposes (Saeed et al., 2001). In the present study (1) 10% formalin (2) 10% neutral buffered formalin and (2) saturated salt solution were injected into the body of goats through carotid artery to keep the gross structure, color, flexibility, texture, histoarchitecture, and histochemical components of the embalmed animals. The gross results showed that the structure, color, flexibility and texture of the skeletal muscles and viscera of the 10% neutral buffered formalin embalmed goats were well fixed and durable for one month for the study in comparison to 10% formalin and saturated salt solution. The joint were well moveable in 10% neutral buffered formalin embalmed goats and the skeletal muscle, intramuscular connective tissues, soft organs showed standard histological architecture.

Alcoholic Fixation for Preservation of Tissues in Bangladesh

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Abstract
The search for formalin substitute has been evolved by two fundamental developments- it is hazardous and the fact that formalin does not assure a complete RNA recovery, essential to molecular biology now. Under these

circumstances, the alternative may be alcohol-based fixatives. Fast fixation, optimal preservation of specimens and a safer workplace environment, are some of the advantages of alcoholic fixation over formalin fixation. Therefore, our present study was designed to examine the efficacy of presumably less toxic alcoholic fixative (modified EthMeth) as an alternative to formalin. Our gross study showed that it was faster in penetration of tissues than formalin, fixed tissues ideally as early as 8 hours of fixation whereas improper fixation was evident for formalin at that time. In hematoxylin and eosin (H & E) staining, cellular disintegration and weak affinity for staining were evident for formalin. But alcoholic fixatives preserved tissue architectures better than formalin. Our nucleic acid (DNA and RNA) analysis revealed that total genomic DNA and RNA yield and quality of the modified EthMeth fixed tissues were significantly higher ($P < 0.05$) than formalin fixed tissues (poor preserver). These results suggest that alcoholic fixative could be a safe alternative to formalin for morphologic and molecular analysis of tissues.

Distribution and Biocompatibility of Seaweeds in the South-Eastern Coast of Bangladesh

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Abstract

Seaweed is a natural gold for strengthening the blue economy in Bangladesh. It has been used for decades as livestock feeds or feed additives worldwide. Their seasonal abundance and elemental composition vary depending on the geographic location and nature of the water bodies. Our research was materialized to know the seasonal distribution and elemental composition of *Gracillaria sp., Ulva sp.* and *Eneteromorpha sp.* in the South-Eastern coast of Bangladesh. For this purpose, a temporal survey was conducted to know the monthly distribution of seaweeds in different areas of the South-Eastern coasts. The representative samples were collected for detecting their nutritive value and bioactive compounds. Our results showed that Saint Martin Island was the hotspot for the seaweeds in Bangladesh but sporadically distributed in the different areas of Cox's Bazar. *Eneteromorpha sp.* was found from October to April but *Gracillaria sp.,* and *Ulva sp.* were mostly found from January to March. The highest crude protein and fat content with the lowest crude fiber was found in *Gracillaria sp.,* but the highest ash content was recorded in *Eneteromorpha sp*. The heavy metal levels were detected below the hazard index in all of the selected species. However, the highest level of As was found in *Ulva sp*. whereas the lowest was in *Enteromorpha sp*. The Pb and Cr levels were the highest in *Gracillaria sp*. but the lowest was in *Ulva sp*. Cu, Fe, Mn levels were higher in *Enteromorpha sp*. than others. These results suggest variable seasonal distribution and nutritive value, heavy metals, and trace elements depending on the seaweed species native to Bangladesh.

Chitosan Oligosaccharides for Improving the Intestinal Morphology and Health Physiology in Broilers

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Abstract

Chitosan oligosaccharides (COS) is a relatively new feed additive that is a derivative of chitosan, a non-toxic linear polysaccharide with many biological functions. To investigate the efficacy of COS on gut morphology and serum biochemical profile (lipid, protein, glucose, creatinine and enzymes), a total of 180 day-old broiler chicks (n = 45) were allocated into allocated to 1 of 4 groups: control (T0) and treatment groups (T1, T2 and T3) fed basal diet supplemented with increasing amounts of COS for 35 days. Our findings showed that dietary COS supplementation had positive effects on the body weight and body weight gain in the treatment groups. Villus height and width, ratio of villus height and crypts depth, and tunica mucosa thickness of duodenum increased ($P > 0.05$) in the treatment groups (T1 and T2), whereas crypts depth of duodenum and cecum were decreased in the treatment groups (T1 and T2) compared to the control group; treatment group 3 (T3), however, was almost similar to the control group. In the case of cecum, tunica mucosa thickness, length and width of mucosal folds showed similar results as duodenum.

The population and size of intestinal glands and lymphocytic infiltration in the mucosa were increased considerably in the treatment groups (T1 and T2) than control group. Total serum cholesterol, triglyceride, LDL and VLDL cholesterol levels were significantly lowered in the treatment group 2 (T2) than control group or other COS treated groups ($P < 0.05$), although HDL cholesterol level was significantly ($P < 0.05$) higher in all of the treatment groups, but substantially higher in the group treatment groups 1 and 3 (T1 and T3) compared to control group. Total serum protein, albumin, and globulin were gradually increased in all of the treatment groups along with the increasing dose rates. The liver and kidney functions (ALT, AST and creatinine) were not significantly ($P > 0.05$) affected due to COS supplementation. These results suggest that COS has a dose-dependent response to improve gut morphology and health physiology in broilers; low to medium doses are more favorable for safe poultry production as it enhances growth performance, increases villus surface area, reduces undesirable cholesterols and positively affects the blood glucose and protein levels. These results would be helpful in exploring the efficacy of COS as a potential feed additive for safe poultry meat production, which is a time-demanding issue for the poultry industry from the consumers' point of view.

Impact of Dietary Steroid Supplement on the Productive Performance and Meat Quality Attributes in Broiler

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Abstract

Growth promoters are added with broiler feed to boost the overall feed efficiency and growth rate. The current study investigated the effect of dexamethasone (DEX)—a commonly used growth promoter—on the broiler growth rate, meat quality, and muscle biology. Four homogenous groups (20 chicks/group) of broiler one-day-old chicks were fed commercial broiler feed where the treatment groups received 3, 5, and 7 mg/kg of DEX with their diet for 28 d. Feed consumption and body weight were monitored on a daily basis. Muscle samples were collected on 7, 14, 21, and 28 d of the experiment to investigate meat quality and muscular biology. The residue of DEX in meat was detected using thin-layer chromatography. We observed that DEX had substantially decreased ($P < 0.05$) feed intake, feed efficiency, and overall weight gain in the broiler. While the weight of breast and thigh meat was decreased, the relative meat weight (meat/body weight) was increased significantly in chicks fed DEX. Simultaneously, body fat decreased while the percentage of fat increased significantly ($P < 0.05$) in the DEX groups. Contrariwise, DEX improved the investigated meat quality parameters with the potential threat of accumulation of DEX residue in the meat at a high dose (7 mg/kg). We also observed that DEX significantly increased the number of myofibers and decreased the cross-sectional area of myofibers. Based on these findings, we conclude that DEX reduces feed intake, feed efficiency, and growth rate, but might improve meat quality with a potential risk of residual DEX accumulation if fed at a high dose.

Investigation of Residual Effect of Pesticide Contamination of Market and Field Vegetables on Vital Organs of Adult Male Rabbits (*Oryctolagus cuniculus*)

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Abstract

Pesticide residue in food and food-related products is a concern to the public health, ecosystem, biodiversity, soil health, and water quality. The most well-known and often applied broad-spectrum insecticide with a favorable toxicity profile in humans is imidacloprid (IMI). By assessing serum biochemistry and examining gross and microscopic tissue changes, the current study was designed to assess the impacts of toxicity of IMI and market/field

vegetable feed in the visceral organs of rabbits. A total of 24 adult male rabbits were chosen and divided into the control group (n=8), IMI-exposed group (n=8), and market vegetable feed group (n=8). IMI-contaminated green grass IMI [Imidacloprid, Bildor® 0.5 ml (100mg)/L water] was given to IMI-exposed rabbits for every alternate day up to 15 days, and market vegetables for every alternate day for 15 days. The hepatic serum AST and AST level was significantly higher ($P \leq 0.05$) in both IMI-contaminated feed and market/field vegetable feed rabbits compared to control rabbits, indicating liver lesions. In both IMI and market vegetable feed rabbits, histopathological examination of the liver revealed coagulation necrosis, congestion, and significant infiltration of inflammatory cells on the peri-portal and portal area. In the lungs, around the terminal bronchiole granulomatous inflammation was seen. Accumulations of inflammatory cells were observed in the cortico-medullary junction in the kidney. The heart showed necrosis and infiltration of mononuclear cells within the cardiac muscles. Thus, the research results will offer a considerable understanding of the toxicity of IMI and contaminated-market vegetable feed exposure in mammals.

Effects of Dietary Supplementation of Edible Vegetable Oils on the Hemato-biochemical Parameters of Rabbit: a Health Perspective Study in Bangladesh

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Abstract
The aim of the present study is to assess the consecutive effects of long-term dietary intake of vegetable oils on the hemato-biochemical parameters of the experimental rabbits. Vegetable cooking oils are essential to the human diet since they are the main source of lipids. Thermal oxidation of oils indeed occurs when they are heated at high temperatures. Total 30 experimental rabbits were divided into 5 groups (n=6); Group A: control group, Group B: soyabean oil treated (SBO), Group C: palm oil treated (PO), Group D: mustard oil treated (MO) and Group E: sunflower oil treated group (SFO) at the dose of 2 ml/kg/day through orally. Body weight and blood pressure were monitored before the treatment (Day 1) and at every month up to 6 months duration of the experiment. The blood samples were collected from ear vein. In this study, the higher body weight gain was found in SBO and the lower was found in SFO in comparison to CO. On the other hands, systolic pressure was found higher in PO and diastolic pressure was found higher in SBO. The results of the study indicate that glucose level high in PO, cholesterol level high in SBO, TP high in SBO, ALB high in SBO, GLO high in SFO, ALP high in SFO, creatinine high in SBO, testosterone high in SBO and troponin high in MO significantly. The ALT, AST and BUN levels were found lower in each group. The SBO treated group showed significant changes in hematological and biochemical parameters in comparison to other groups. Therefore, the research works are designed considering the health impacts of edible vegetable oils and identify comparatively safer edible oils for consumption in Bangladesh.

Role of Hepatic Macrophages in Agricultural Pesticide (Imidacloprid)-Contaminated Feed Exposed Rat Liver

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Abstract
Pesticide is one of the top ten substances that pose a serious risk to the public's health. Imidacloprid (IMI) is a frequently used neonicotinoid, synthetic, systemic broad spectrum insecticide. Here to assess the role of macrophages in hepatotoxicity induced through IMI-contaminated feed exposure in adult male rats (n=12). The rats were grouped into IMI-exposed (n=6) and control (n=6). Control group received/supplied rat pellet with ad libitum drinking water. IMI-exposed rat group received rat pellet with ad libitum drinking water, in addition Imidagold® (IMI) @ 45 mg/kg b.wt. was given orally at morning by oral gavage needle every alternative day for 7 days. At days 16, after deep chloroform anesthesia, blood was collected directly from the heart for serum collection and liver was collected for histopathology and immunohistochemistry. The AST and ALT increased significantly in IMI-exposed rats. Histopathologically, liver showed coagulation necrosis, cholangitis and infiltration of huge number of

inflammatory cells in the periportal areas. Immuno-histochemistry of liver revealed that Iba-1 positive macrophage, CD-8 positive, T-lymphocytes, and fibroblast (vimentin)-positive cells were increased in periportal and Glisson's sheath of IMI-exposed liver compared to control. The statistical analysis showed that, the number of Iba-1 positive macrophage, CD-8 positive T-lymphocytes, and vimentin-positive fibroblast cells were significantly increased in IMI-exposed rat liver in comparison with control rat liver. The results suggest that macrophages, T-lymphocytes and mesenchymal cells have an important role in the pathogenesis of IMI hepatotoxicity in adult male rats.

Gastrointestinal Tract Morphometrics of Sonali, Cock and Indigenous Chicken in Bangladesh

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Abstract
The experiment was conducted to the comparative study of mucosa and mucosa associated of lymphoid tissue in the gastrointestinal tract of indigenous chicken with the sonali and cock. A total of 24, 6-7 weeks old male chicken were used in the study and were divided into 3 equal groups (n=8). After ethically sacrifice, different segments of the gastrointestinal tract were collected. The histomorphological study revealed that the lamina epithelium and tunica mucosa of the esophagus were thickest in the cock, followed by sonali and indigenous chicken. Tunica mucosa of the upper part of proventriculus was thickest in the sonali, followed by indigenous chicken and cock. Duodenal and jejunal villi were highest in the cock, followed by sonali and cock. The villi of the ileum were highest in the cock, followed by sonali and indigenous chicken. Lymphocytic population in upper segments of gastrointestinal tract and small intestine were highest in indigenous chicken due to their scavenging except in the upper part of the proventriculus. The lymphocyte population of Meckel's diverticulum were highest in cock, followed by sonali and indigenous chicken. The thickness of mucosa and depth of the crypts of Lieberkühn of caecum were highest in indigenous chicken, followed by sonali and cock. The lymphocyte population of caecum were highest in sonali. The highest length of lymphatic nodules of cecal tonsil were documented in indigenous chicken. The highest depth of the crypts of Lieberkühn of cecal tonsil were found in cock, followed by indigenous chicken and sonali. The lymphocyte population of cecal tonsil were highest in indigenous chicken and cock. The thickness of tunica mucosa and depth of the crypts of Lieberkühn of colo-rectum were highest in broiler, followed by sonali, indigenous chicken and cock. The lymphocyte population of colo-rectum were highest in cock, followed by sonali, and indigenous chicken.

Development of Antioxidants Based Antidote Against Pesticide (Imidacloprid)-induced Hepatotoxicity in Rats

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Abstract
Imidacloprid (IMI) is a frequently used neonicotinoid, synthetic, systemic broad spectrum insecticide. Here to assess the mitigation role against IMI-induced hepatotoxicity by supplementing antioxidants (vitamin E & Se and vitamin C) in IMI-exposed adult male rabbits. Twenty-five adult male rabbits were divided equally into 5 groups, namely: Group-1 (control), Group-2 (IMI-exposed), Group-3 (IMI + Vit E), and Group-4 (IMI + Vit C). Rabbits of Group-1 received pesticide-free green grass, and Group-2 received IMI (Imidacloprid, Bildor® 0.5 ml (100 mg)/L water) contaminated green grass every alternative day once daily for up to 15 days. Rabbits of Group-3 and 4 received IMI-contaminated green grass, simultaneously Vit E-Se (Vit E @ 75 mg/L drinking water and Se @ 0.25 mg/L drinking water) and Vit C (100 mg/L drinking water) was given in the aqueous form in respective groups on every alternative day once daily up to 15 days. Imidacloprid induces hepatotoxicity which damages the liver and, particularly coagulation necrosis infiltrated with numerous inflammatory cells, and cholangitis. No histopathological changes were seen in the liver of antioxidant-supplemented rabbits. Immuno-histochemistry of liver revealed that Iba-1

positive macrophage, CD-8 positive, T-lymphocytes, and fibroblast (vimentin)-positive cells were increased in periportal and Glisson's sheath of IMI-exposed liver compared to control. The statistical analysis showed that, the number of Iba-1 positive macrophage, CD-8 positive T-lymphocytes, and vimentin-positive fibroblast cells were significantly increased in IMI-exposed rabbits liver in comparison with control rabbits liver. Interestingly, their numbers remained normal in antioxidants treated rabbits, indicating that antioxidant properties of Vit E-Se, Vit C have a protective role against IMI-induced hepatotoxicity in rabbits. The results suggest that the residue of IMI induced hepatotoxicity which can be mitigated using different antioxidants like Vitamins C and E.

Cryodehydration Technique in Preserving the Macro and Microscopic Details of Goat Visceral and Musculoskeletal Specimens

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Abstract
This study sought to determine the effectiveness of cryodehydration technique in preserving the morphologic and morphometric attributes of the anatomical specimens of goat. Different anatomical parts of a goat, i.e., heart, lungs, spleen, liver, kidney, and musculoskeletal specimens, were collected and fixed in 15% formalin. Later on, the fixed specimens were cryodehydrated by fast freezing (burning process) and repeated freezing-thawing sessions, followed by wood glue coating. Finally, the macroscopic (i.e., weight, color, texture, odor, and durability) and microscopic characteristics (by routine Hematoxylin and Eosin staining) of the cryodehydrated specimens were studied. The resultant specimens produced excellent color and texture and were lightweight (60-80% weight loss), soft, dry, odorless, durable, and easy to handle. The histoarchitectural details of the heart and skeletal muscle were well preserved while some distinctive alterations were observed in the parenchymatous organs, i.e., breach in cellular integrity, loss of cell cytoplasm, loss of cytoplasmic and nuclear clarity, increased sinusoidal space, dilatation of the renal tubules, and reduction in glomerular size. Nevertheless, the basic histoarchitectures of each specimen were yet distinctly identifiable. The current study findings suggest that the cryodehydration technique can preserve gross anatomical features as well as histoarchitectural details and can be an effective tool for facilitating veterinary education and research.

Chronic Effects of Imidacloprid Contaminated Feed Exposure on the Spleen, Lymph Node, and Mucosa-associated Lymphoid Tissues of Adult Male Rabbits (*Oryctolagus cuniculus*)

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Abstract
Pesticide is one of the top chemical substances that pose a serious risk to public health. Imidacloprid (IMI) is a widely used broad-spectrum insecticide over the past decade. Here, oral IMI-contaminated green grass (at the dose rate of 100 mg/liter and sprayed) was fed to adult male rabbits (n=6), every alternate day for up to 90 days. The control rabbits (n=6) were fed pesticide-free green grass, wheat bran, and water ad libitum. For gross and histopathology, spleen, lymph nodes, and mucosa-associated lymphoid tissues were collected by ventromedial opening. No evident gross changes were found during the collection of the organs. Histopathologically, lymph nodes showed atrophy and degenerative lymphoid follicles. The cortex and medulla of the lymph nodes were less differentiated. The size and number of the lymphoid follicles in the cortex were also reduced in IMI-exposed rabbits. The spleen exhibited atrophic changes in the white pulps. The white pulp revealed degenerative changes with the depletion of the lymphoid tissues. As for the red pulp, it showed an irregular and depleted mesh network of reticular fibers in IMI-exposed rabbits compared to the control. The trachea and esophagus of IMI-exposed rabbits showed infiltration of the mononuclear cells in the propria-submucosa and tunica adventitia, respectively. The infiltration of mononuclear cells population was loaded in the core of the villi, tunica mucosa, and propria-submucosa of the duodenum, jejunum, and ileum of the IMI-exposed rabbits compared to the control. The present study findings suggest that IMI has toxic effects on the lymphoid organs and tissues of adult rabbits.

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Anatomy Museum: Enhance Quality Veterinary Education and Research

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Abstract
The museum is a center for learning new information or knowledge through visual observation. Anatomy museum explores the knowledge based on the shape and structure of living beings as a whole or part. This study was aimed to enrich veterinary anatomy museum collecting samples and preparing the skeletons, preserve, interpret, and display items of artistic, cultural, or scientific significance for the education of the educators and public. In this research, we also described a simple technique for preserving the skeleton, stuffing or plastinates for the teaching of animal structures, organs or animal as a whole. For preservation of the skeletons, the animals were sedated, skinned then internal organs removed. The sample was boiled with lemon soap extract combined with baking soda and kept in bleaching agent. The bones were washed out with clean water and sun-dried. The bones were arranged and connected using glue and wire. Finally, the skeleton was fixed on a wooden stand to be stored easily for animal structures in teaching purposes. The stuffing process involves keeping the appearance of an animal intact using cotton, iron rod, wire and some chemicals after removing and processing the skin of a dead animals. In the meantime, a good number of skeletons (Elephant, Giraffe, Goyal, Common eland, Deer, Monkey, Arabian horse, Dog, Cat, Chicken, Duck, Turkey, Civet, Dolphin, Snake etc.), stuffed birds/animals (rabbit, cock, pigeon. duck etc.), and organs of animals were preserved. Implementation this technique for animal structure teaching based on inquiry-discovery learning shown that students have good process skill (cognitive process, knowledge, creativity and innovation). The anatomy museum offered great promise to cope with anatomy practice in veterinary education and another science subjects as well. In conclusion such a museum will certainly have a more holistic approach to anatomy study and will be more educative and scientific.

A One-Health Approach to Understanding the Drivers of Antimicrobial Resistance in Enterobacteriaceae from Bangladesh

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Abstract
Antimicrobial resistance (AMR) is recognized as an emerging global crisis in the 21st century, menacing a century of medical progress evidenced by the United Nations and World Health Organization. Published reports demonstrated high carbapenem resistance Enterobacterales prevalence (about 30%) in the Bangladeshi public health sector and the recent emergence of MCR-mediated colistin resistance. This situation is worrisome, limiting therapeutic options and possible treatment failures even to the 'last line' antibiotics. However, data on transmission dynamics and potential drivers of AMR in Bangladesh is still limited. To address this gap in our understanding, a comprehensive 'One Health' approach has been deployed in this study based on sampling in poultry, environment, and humans supported by detailed state-of-the-art genomics. Samples and data were collected from five different subdistricts of Mymensingh, Bangladesh, including Mymensingh Medical College Hospital and different poultry farms. Urine samples were collected from hospital patients, swab samples from poultry, and water samples from farms and hospitals. Data were collected from farmers and human volunteers using structured questionnaires. Following sample collection, all samples and data were transferred to the University of Oxford, UK, maintaining proper documentation and ethical approvals. Then, all the samples were subjected to isolation and identification using MALDI-TOF. In the case of urinary tract infections among the culture-positive samples (n=158), the prevalence of *E. coli* was 71% (114/158), *Klebsiella sp.* was 14% (22/158), whereas 24% (24/158) was other Gram-

negative bacteria. In the case of chicken cloacal swabs (n=200) and water samples (n=200), the prevalence of *E. coli* was 97.5% (195/200) and 49% (98/200), respectively, whereas the prevalence of *Klebsiella sp*. was 41% (82/200) and 26.5% (53/200), respectively. MIC assays will be performed using the agar dilution method to determine antibiotic sensitivity. Then, whole genome sequencing (using Illumina MiSeq and PromethION platform), bioinformatics, and data analysis will be performed. Finally, pathogenicity, fitness, and stability tests for the isolates of interest will be conducted. This is the most comprehensive study on AMR in Enterobacterales in Bangladesh. The findings will describe the prevalence, dynamics of dissemination, and risk factors of AMR in poultry, environment, and health settings. By reporting the data to the Bangladesh Ministry of Agriculture, Bangladesh Ministry of Livestock and Fisheries, and Bangladesh Ministry of Health, this study will contribute to generating policies on antibiotic usage in poultry, food chain, and human medicine alongside the Government.

Molecular Detection, Cultivation and Characterization of Infectious Bursal Disease and Newcastle Disease Viruses from Chickens

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Abstract

The most economically devastating infectious diseases affecting Bangladesh's poultry industry are Newcastle disease (ND) and Infectious Bursal disease (IBD). The research was undertaken to detect, cultivate and characterize the Infectious bursal disease and Newcastle disease viruses from chickens of selected areas of Bangladesh during the period from May 2023 through February 2024. Depending on the post mortem lesions, a total of 41 IBD suspected samples (Bursa of fabricious) and 62 ND suspected samples (lung, trachea and caeca tonsil) were collected from chickens from Gazipur, Tangail and Mymensingh districts of Bangladesh. Following sample processing, 10-12 days old embryonated chicken eggs (ECEs) were injected with the inoculums of RT-PCR positive 29 IBDV and 25 NDV samples separately through chorio-allantoic membrane (CAM) and allantoic cavity route of inoculation respectively. After being inoculated, the CAM as well as tissues of the embryo and allantoic fluids from the embryonated chicken eggs were collected respectively. IBDV was confirmed by RT-PCR using VP2 gene specific primers and the NDV identity was initially performed by HA test and then confirmed by RT-PCR using matrix (M) and fusion (F) gene-specific primers. The pathotype of NDV isolates was determined by MDT and further confirmation was achieved through partial sequencing. 3 isolates from embryonated chicken eggs out of the 29 samples (10%) were confirmed as IBDV by RT-PCR and 7 isolates from embryonated chicken eggs out of the 25 samples (28%) were verified as NDV through HA and RT-PCR. The MDT index and partial sequencing results indicated that the NDV isolate was velogenic strain. The study revealed that IBDVs and the velogenic strains of NDVs are circulating among the poultry population at selected areas of Bangladesh triggering death of chickens.

Molecular Detection and Characterization of Foot and Mouth Disease Virus and *Pasteurella multocida* type B:2 in Cattle of Bangladesh

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Abstract

Foot and mouth Disease (FMD) and hemorrhagic septicemia (HS) are the two infectious diseases that have the greatest financial impact on Bangladesh's cattle industry. The research was carried out for the isolation and characterization of foot and mouth disease virus (FMDV) and *Pasteurella multocida* type B:2 in cattle of Bangladesh during the period from March 2023 through February 2024. From 11 distinct outbreak areas in Bangladesh, a total of 315 FMD samples (Saliva, tissue epithelium and morbid tissues including lung, spleen and

heart) and 51 HS samples (Nasal swab and morbid tissues) from clinically suspected cattle of various ages and sex groups were collected. Following sample processing, molecular detection of FMDV and its serotypes was performed by RT-PCR amplifying VP1 gene using universal and serotype specific primers. Further confirmation was achieved through partial sequencing. HS-causing agent *Pasteurella multocida* type B:2 was initially identified by cultural and morphological characteristics on blood, MacConkey`s, EMB and SS agar followed by gram`s and methylene blue staining; biochemical characteristics of sucrose fermentation, methyl red, indole, vogues proskeur and catalase test; and pathogenicity characteristics through inoculation of isolates into mice. Finally, molecular detection was achieved by PCR amplifying 6B genes using specific primers. Through RT-PCR and partial sequencing, FMDV and its serotypes O and A were detected. Phylogenetic analysis demonstrated that sequenced O and A isolates were close to Pan-Asia strains. Cultural, morphological, biochemical and pathogenicity characteristics and finally, molecular detection by RT-PCR confirmed the isolates of *Pasteurella multocida* type B:2. The present research revealed that FMDV serotype O is more prevalent followed by A and hemorrhagic septicemia cases are still continuing in cattle of Bangladesh.

Molecular Detection and Genetic Characterization of Duck Viral Hepatitis Virus in Ducks of some Selected Areas of Bangladesh

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Abstract
Duck Viral Hepatitis Virus (DVHV) is an acute, highly contagious virus that often causes disease in ducklings and has a high mortality of around 95%. Among the three serotypes, DHAV-1 is globally distributed, whereas DHAV-2 and DHAV-3 serotypes are predominantly restricted to Southeast Asia. Live ducklings were showing nervous signs of opisthotonos and hemorrhagic lesions on the liver of dead ducklings. In this study, a total number of 72 liver samples were collected from suspected ducklings of less than six weeks of age. Samples were collected from Netrokona Sadar, Mohonganj, and Mymensingh Sadar, Bangladesh. Samples were processed and RNA was extracted using Monarch® Total RNA Miniprep Kit following the manufacturer's instructions. Reverse Transcription PCR (RT-PCR) was performed using primers pair F:5′-CCTCAGGAACTAGTCTGGA-3′, R:5′-GGAGGTGGTGCTGAAA-3 and F:5′ATCAGGGTGATTCTAACCAG-3′, R: 5′-CTTATTTCTAATTTGGTCAG-3′, targeting 5´UTR and VP1 gene respectively. The targeted amplicon size for the 5'UTR and VP1 genes would be 250bp and 734bp respectively. Amplified segments were separated on 1% agarose gel along with a 100bp DNA ladder and visualized under a gel documentation system. No samples were found positive for DVHV.

Evaluation of Factors Influencing Self-Medication Practice with Antibiotics and its Impact on Antimicrobial Resistance among Rural People in Bangladesh

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Abstract
Antimicrobial resistance is an emerging global health threat. Bacteria develop resistance to antibiotics and render these medications ineffective. Self-medication, abuse, or indiscriminate use of antibiotics contribute to the development of antimicrobial resistance. This practice is very common in rural people of Bangladesh. Thus, this study aimed to identify the factors influencing them to take self-medication, and interpret its impacts on AMR development. A total of 456 data were collected randomly and analyzed by fitting binary logistic regression model and chi-square test using IBM SPSS and Microsoft Excel software. Prevalence of self-medication was higher among male (86.83%), and uneducated (97.3%) people than the female (76.77%) and tertiary educated people (70.52%) respectively. There was a very minor significance of family income in this practice. Employment status (p0.01, 95% CI: 0.048-0.474), family members in the health sector (p0.05 95% CI: 0.190-0.856), preferring self-treatment for

minor illness (p0.05, 95% CI: 1.144-5.125), knowledge of antibiotics adverse effects (p0.01, 95%CI: 1.991-26.449) were the significant factors influences this practice. A total of 90 rectal samples were collected from the persons we collected data. As *E.coli* is a commensal organism of human gut flora, considered an opportunistic pathogen and a major donor of antimicrobial resistance gene to pathogenic bacteria. *E.coli* was isolated by sub-culturing several times on EMB and MacConkey agar media, and identified by different biochemical tests and PCR amplification of *16srRNA* gene. A total of 43 *E.coli* were isolated and antibiotic sensitivity was performed against 10 most commonly sold antibiotics. All the isolates expressed 100% resistance to penicillin and cefixime. Isolates that emerged from the person's practice of self-medication revealed resistance against more antibiotics than isolates from the person avoided. Antibiogram data and those people's different characteristics were analyzed to identify the involvement of those characteristics in MDR development. Self-medication, incompletion of antibiotic courses and antibiotic switch (p0.01) were significantly associated with MDR. In conclusion, the findings revealed that inadequate knowledge and awareness about antibiotics influences the rural population to take self-medication which is very alarming for their health.

E. albertii in Chicken Meat: A Probable Source of Human Infection in Bangladesh

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Abstract

Escherichia albertii is an enteric pathogen and was reported from a diverse environmental setting including chicken. Although firstly reported from human in Bangladesh, no further studies were documented since its inception from this country. Thus, this study was aimed at the molecular detection and characterization of *E. albertii* from broiler meat, the major animal protein source in Bangladesh. A total of 61 whole dressed broilers were bought from the retail outlets of Mymensingh district. Four different types of samples including breast, thigh, proventriculo-gizzard and liver were collected from each broiler and processed separately. In addition, rectal swab from broilers and human hand swab was collected before slaughtering the broiler. Sample was homogenized in 9 times buffered peptone water and enriched overnight at 37°C followed by detection of *E. albertii* by Eacdt gene PCR. *E. albertii* was isolated from the positive samples onto *E. albertii* specific XRM-MacConkey agar media and genotyping was performed by PFGE and ERIC PCR. *E. albertii* was detected in 61.1% (149/244) of meat and 68.5% (24/35) of rectal swab of broiler, and 36.4% (4/11) of human hand swabs. From PCR positive samples *E. albertii* were isolated and examined by PFGE which revealed 4 different genomic patterns. Interestingly, isolates from human hand, broiler meat and rectal swab from the same outlets revealed similar ERIC pattern indicating possible transmission of the bacterium from broiler to human probably through fecal contamination. Moreover, all the isolated *E. albertii* was multidrug resistant containing resistance gene for beta-lactam (blaTEM-1), tetracycline (*tetA* and/or *tetB*) and quinolones (*qnrS*). Occurrence of MDR *E. albertii* in broiler meat indicates a potential threat to public health. However, further studies are required for detailed characterization and exploration of transmission potential of *E. albertii* to human through broiler meat.

Molecular Diversity of *Streptococcus* spp. Isolated from Clinical Mastitis in Dairy Cattle of some Selected Dairy Farms of Bangladesh

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Abstract

Streptococci are the major etiology in mastitis, a cause of huge economic losses in the dairy industries. This study was aimed to determine the diversity of *Streptococcus* spp. isolated from clinical mastitis of cattle reared in Bangladesh. A total of 843 lactating cattle reared in four prominent dairy farms and one dairy community were purposively included in this study where 80 cattle were positive to clinical mastitis based on gross changes in the udder (redness, swelling, and sensitive udder) and/or milk (flakes and/or clots). Milk samples were collected from all the eighty (80) cattle with clinical mastitis (CCM) and enriched in Luria Bertani broth (LB). *Streptococcus* spp.

was isolated from the enrichment culture onto Modified Edwards Medium and identified by 16S rRNA gene sequencing. Eighteen (22.5%) of the samples were positive for *Streptococcus* spp. by cultural and molecular examination. Sequencing and phylogenetic analysis identified 55.6%, 33.3%, 5.6% and 5.6% of the *Streptococcus* isolates as *S. uberis*, *S. agalactiae*, *S. hyovaginalis* and *S. urinalis*, respectively. Molecular characterization through whole genome sequencing of five (5) *S. uberis* isolates identified at least two novel ST types of *S. uberis*, indicating the presence of at least two different genotypes of *S. uberis* in the study areas. On virulence profiling, all the isolates harbored at least 35 virulence and putative virulence genes probably associated with intramammary infection (IMI) indicating all the *S. uberis* isolated in this study are potential mastitis pathogen. Overall findings suggest that *Streptococcus* encountered in bovine mastitis are diverse and *S. uberis* might be predominantly associated with CM in the study areas. The *S. uberis* genome carries an array of putative virulence factors that need to be investigated genotypically and phenotypically to identify a specific trait governing the virulence and fitness of this bacterium. Moreover, the genomic information could be used for the development of new genomic tools for virulence gene profiling of *S. uberis*.

Development and Adaptation of a Simple, Rapid and Confirmatory Test Methods for the Detection of Viruses of FMDV, LSDV and PPRV from the Live and Post Slaughtered Cattle, Buffalos, Sheep and Goat from Different Slaughter Houses of Bangladesh for Ensuring Supply of Healthy Meat to the Consumers

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Abstract

Present study was conducted to isolate and identify predominant serotypes of FMDV and also LSDV from the affected cattle of selected districts of Bangladesh. A total of 55 samples were collected from FMD suspected cattle. Of the 55 samples, 42 were found FMD positive by qRT-PCR, of which 25 were sero-type O, 14 for A and 3 for both A & O. Only 14 were type O and 6 were types A for virus isolation in BHK-21 and re-confirmed by qRT-PCR. Histopathology of the heart muscle and tongue epithelium showed disintegration in the muscle bundle, fragmentation of the nucleus, vacuolation, and mono-nuclear infiltration, which are the characteristic lesions of FMD. This study, it clearly indicates that the predominant circulating serotype of FMDV is type O in Bangladesh. For LSDV a total of 38 nodular mass skin lump tissue samples were collected from 19 affected cattle during August to December 2023. Field samples were collected into two parts: one for viral antigen detection and isolation, and another for histopathology. Most samples were subjected to molecular screening by iiPCR, real-time PCR (rpo 30 gene), and conventional PCR (p32 gene). LSDV isolation from PCR-positive samples was done through propagating into a 10-day-old chicken embryonated egg through the CAM route. Most samples were collected from days three to ten were found positive by iiPCR, real-time PCR, and PCR. Phylogenetic analysis of the nucleotide sequences of the rpo30 gene clearly indicates that the recent circulating isolates of LSDV have close similarities with the isolates of India, Myanmar, and Mongolia. Histopathological findings of nodular skin tissue showed degeneration of epithelial cells, parakeratosis and hyperkeratosis in the epidermis, mononuclear cell infiltration, and vasculitis in the dermis. Development of rapid Ag detection kit for FMDV is under progress.

Immune Response of Inactivated Oil Adjuvant Brucella Abortus Vaccine in Cattle in Field Trials

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Abstract

Vaccination serves as a pivotal measure in managing brucellosis in cattle. This study aimed to evaluate the humoral immune response in cattle following vaccination with an oil adjuvant Brucella abortus vaccine. Brucella abortus

biovar 3 (BAU21/S4023) was rendered inactive using 1% formalin, with mineral oil incorporated as an adjuvant. A cohort of 80 cattle received subcutaneous injections of 2 ml (3×10^8 CFU) of the inactivated oil adjuvant Brucella abortus vaccine. A booster vaccination was administered 60 days after the initial dose. Serum samples were collected from vaccinated cattle at intervals of 0, 15, 30, 60, and 90 days post-vaccination (dpv). The Brucella abortus-specific antibody titer was assessed using the rose Bengal plate test (RBPT) and Indirect ELISA.The reciprocal RBPT antibody titers in vaccinated cattle sera were observed to be 16 at 15 dpv, 16 at 30 dpv, 8 at 60 dpv, and 16 at 90 dpv. In tandem, the Indirect ELISA OD values for vaccinated cattle sera were 0.235±0.002, 1.830±0.031, 1.768±0.263, 1.979±0.012, and 2.555±0.374 at 0, 15, 30, 60, and 90 dpv, respectively ($p<0.05$). No detectable antibodies were observed at 0 dpv via RBPT and Indirect ELISA. The findings of this study underscore the robust humoral antibody response induced by the inactivated oil adjuvant B. abortus vaccine in vaccinated cattle. Consequently, this vaccine presents promise for the effective control of bovine brucellosis in Bangladesh.

Sero-epidemiology and Molecular Detection of Brucella Infections in Sheep and Goats in some of the Selected Districts of Bangladesh

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Abstract

Brucellosis is a bacterial zoonotic disease that infects a wide range of ruminants and humans. This study aimed to determine the seroprevalence, molecular detection and associated risk factors of brucellosis in sheep and goats in the districts of Mymensingh, Jhenaidah, and Meherpur in Bangladesh. Serum samples were collected from 150 sheep and 150 goats, sourced from household farms, commercial farms, veterinary hospitals, and slaughterhouses. A well-structured questionnaire was employed to gather data on animal age, sex, breed, management practices, and reproductive disorders. Serum samples were screened using the Rose Bengal Plate Test (RBPT) and indirect ELISA to detect Brucella-specific antibody responses. The overall prevalence of brucellosis was found to be 4.7% in sheep and 2.9% in goats across the study areas. Specifically, the prevalence of brucellosis in goats was 3.8% in Jhenaidah district and 3.17% in Mymensingh. Among sheep, the prevalence was 5.9% in males and 3.7% in females, while among goats, it was 6.5% in females. Animals experiencing abortion exhibited a higher prevalence of brucellosis, with rates of 16.7% in sheep and 22.2% in goats. The prevalence of brucellosis in sheep at slaughterhouses was 4.8%. Additionally, the prevalence was higher in crossbred goats (3.84%) compared to Black Bengal goats (3%). Brucellosis prevalence was 3.52% in free-ranging animals and 2.38% in semi-intensive systems. Animals aged above 2 years showed a prevalence rate of 6.382%. Furthermore, the prevalence of brucellosis in goats was 3.448% on household farms, 2.380% in veterinary hospitals, and 2.85% in slaughterhouses. Brucella spp. was not isolated and identified from sheep and goats in this study. These findings indicate that brucellosis is endemic in the study area, highlighting the need for effective control measures, including public awareness campaigns and improved biosecurity measures in both household and commercial farms.

Identification of an Alternative to Antibiotic Growth Promoter (AGP) for Safe Poultry Meat Production in Bangladesh

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Abstract

Chitosan is a non-toxic polyglucosamine, widespread in nature, which is deacetylated to varying degrees form of chitin, a component of exoskeleton of shrimps, crabs and insects. Chitosan oligosaccharides (COS) is a new and less widely used feed additive. The present study was conducted to determine the effect of COS on growth performances, hemato-biochemical parameters and gut microbiota of broiler chickens. A total of One thousand Lohmann DOCs (day old chicken) meat broilers (500 in controlled shed) and Hubbard Efficiency Plus DOCs (day old chicken) meat broilers (500 in field condition) with initial body weight of 65.2-65.8 grams (control shed) and 70-72 grams (field condition) were equally divided into 5 dietary treatment groups. Presence of any antibiotic

residues (ciprofloxacin, oxytetracycline and doxycycline) in feed supplied to the birds was determined by thin layer chromatography (TLC). Dietary treatments were for group (A) basal diet (BD) without supplement, (B) BD + water soluble COS @ 300 mg L^{-1} of water, (C) BD + water soluble COS @ 400 mg L^{-1} of water, (D) BD + Antibiotic growth promoter @ 1g L^{-1} of water and (E) BD + Probiotics @ 1g L^{-1} of water. The diets were fed in a crumble form for starter phase (1-21 days) and pellet form for finisher (21-35 days) phase. Broiler chicken performances including body weight gain, FCR, hematological parameters, biochemical parameters and immunological parameters of serum, and intestinal bacterial loads were determined using standard methods. Body weight and bacterial load was determined every seven days interval. Whereas hematological, biochemical and immunological parameters were determined at day 0, day 15 and day 30 of the experiment. No residue of ciprofloxacin, oxytetracycline and doxycycline was found in both starter and grower feed. The addition of COS @ 300 mg L^{-1} had a positive effect on increasing feed intake, BW, BWG, and decreasing FCR until end of maintenance compare to other treatment groups. Most of the hematological parameters in all treatments were not different except WBC count. Variation in the biochemical parameters were observed during the study period. No growth of *Salmonella* observed in all groups during the whole period of study. Total viable count (TVC) and total *E. coli* count (TEC) was lower in birds of group B compare to other four groups. The concentration of IgG, IgM and Ig A were also increased in group B compare to other groups in case of both trials. It might be concluded that COS has positive effect on growth performance of broiler chicken.

Human–livestock Contacts and their Relationship in Transmission of Multidrug Resistant Zoonotic Pathogens in Rural Areas of Mymensingh

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Abstract

Livestock farming is expanding world-widely because of increased demands for food of animal origin. Such farming practices pose a public health risk as livestock are reservoirs of several zoonotic pathogens. *Escherichia coli* is a zoonotic bacterium that is important to both public health and livestock economics. To determine the *E. coli* transmission between livestock and human, the bacteria was isolated from the livestock and poultry in a household system including human and identified at the phylogenetic and pathotypic levels with the determination of phenotypic and genotypic antibiotic resistance pattern. A total of 188 rectal, cloacal and hand swabs were collected from 30 households for the isolation of *E. coli* by culture, detection and differentiation by PCR with antibiogram and resistant gene detection. 148 *E. coli* were recovered from samples with the prevalence of 79%, of which 20 (13%) were identified as extraintestinal pathogenic *E. coli* (phylogenetic group B2 and D) and the rest as commensal *E. coli* (phylogenetic group B1 and A). Enterotoxigenic *E. coli* (ETEC) was isolated from cow, hen, chick and duckling; Enterohemorrhagic *E. coli* (EHEC) was from calf, chick and goat; Enteroaggresive *E. coli* (EAEC) from sheep; Enteroinvassive *E. coli* (EIEC) from hen and kid; and Enteropathogenic *E. coli* (EPEC) from cow. Resistance were observed against amoxicillin, oxytetracycline, cefixime, amoxicillin-clavulanic acid, nalidixic acid and ciprofloxacin antibiotics. A majority of the examined *E. coli* isolates were found to carry the *tet*A and bla_{TEM} genes, and 59% of all the isolates showed a pattern of multidrug resistance. The isolation of ETEC, EPEC, and EHEC from chicken and duck suggests that *E. coli* may have transmitted from humans or cattle to poultry, whereas the isolation of EIEC and EAEC from chicken, goat, and sheep suggests a possible transmission of *E. coli* from humans to animals.

Zoonotic *Arcobacter Butzleri* in Humans, Fresh Vegetables and Foods of Animal Origin: Occurrence, Genetic Diversity, Virulence-associated Genes and Antimicrobial Resistance

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Abstract

The first year of this project was designed to recruit project staff and procure consumables, sample collection logistics, media and reagents, DNA extraction kits, and logistics for PCR. The activities mentioned above were

performed successfully. The other activities of the first year of this project were to collect human diarrhoeal stools and different food samples for the isolation and identification of *Arcobacter butzleri* by conventional and molecular methods. These activities are going on.

Zoonotic *Campylobacter jejuni* in Fresh Vegetables: Occurrence, Virulence Characterization and Antimicrobial Resistance Genes

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Abstract
This study aimed to investigate *Campylobacter jejuni*, a major cause of food-borne bacterial infections worldwide, in fresh vegetables from five upzillas (Mymensingh, Trishal, Bhaluka, Muktagacha, and Fulbaria) in the Mymensingh district between July 2020 and April 2023. Using cultural, biochemical, and molecular techniques, 100 fresh vegetable samples (including tomato, carrot, cucumber, green chili, and coriander) were examined for *C. jejuni*. The isolates were further tested for virulence genes and antimicrobial susceptibility. Out of the 100 samples, 23% were confirmed as *C. jejuni*, by 16S rRNA gene-based polymerase chain reaction and all were found to be virulent with cytolethal distending toxins (*cdtA*, *cdtB* and *cdtC* genes). Antibiotic susceptibility testing revealed resistance to amoxicillin (47.83%), tetracycline (43.48%), and streptomycin (39.13%) among the isolates. However, ceftriaxone and ciprofloxacin were effective against 47.83% and 43.48% of the isolates, respectively. Moreover, 52.17% of the isolates were sensitive to erythromycin. Alarmingly, 34.78% of the *C. jejuni* isolates exhibited multidrug resistance (MDR) with eight different antibiotic resistance patterns, including four MDR patterns. These findings highlight the presence of virulent and antibiotic-resistant *C. jejuni* in fresh vegetables, emphasizing the need for monitoring and control to ensure food safety and public health issues.

Epidemiological Study on Campylobacteriosis in the Selected Sheep Farms at Mymensingh and Development of a Protocol for the Long-term Storage of Sheep Blood for *Campylobacter* Growth

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Abstract
Campylobacter infections in sheep may be asymptomatic or cause enteritis, ileitis, infertility, and abortion. Thus, this study aimed to estimate the prevalence of *Campylobacter* spp. in farming sheep and to detect risk factors, molecular patterns, and antimicrobial susceptibility status of these pathogens. Four hundred and eight fecal samples were collected from 12 flocks in the Mymensingh and Sherpur districts. Samples were tested by both basic (culture and biochemical tests) and molecular (initially 16S rRNA and later *hipO* gene-based polymerase chain reaction). Furthermore, the antimicrobial susceptibility status of *Campylobacter jejuni* was confirmed using disk diffusion. Flock- and animal-level data were captured using semi-structured interviews with farm owners under bivariate and multivariate logistic regression analyses to confirm the risk factors for *Campylobacter*-positive status. The prevalence of *C. jejuni* at the animal and flock levels was 8.82% (36/408) and 66.70% (8/12), respectively. The age of sheep was identified as an important risk factor. Up to 1 year of age, sheep were 3.78 times more likely to be infected with *C. jejuni* (95% confidence interval: 1.0736-13.3146, p=0.038). Of the 36 isolates of *C. jejuni*, all were found to be fully susceptible (100%) to gentamicin and ciprofloxacin. In this study, three antimicrobial agents, oxytetracycline, azithromycin, and ceftriaxone, were fully resistant (100%). The majority of isolates were resistant to a combination of 4-6 antimicrobial agents. This study has also developed a protocol for the long-term storage of sheep blood for *Campylobacter* growth. The present study highlights the predominant maintenance of zoonotic *Campylobacter* species in sheep, and their burden on human health is enormous. Therefore, environmental, animal, and human health needs to be focused under a One Health lens to mitigate the occurrence of *Campylobacter* in farm settings and to prevent further introduction to animals and humans.

Isolation and Molecular Detection of *Leptospira* spp. in the Rodent of Selected Areas of Mymensingh Division

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Abstrct
Leptospira is one of the most important zoonotic bacteria which affects humans and animals, is known as leptospirosis in all over the world. Rats are the most important reservoir of Leptospira but domestic and wild mammals may also act as important maintenance or accidental hosts. It is endemic in many countries but this disease is not well recognized in Bangladesh. Socio-economically it is also very important threat to our livestock industry. This study was conducted to isolate and characterize Leptospira from rat population through cultural, dark field microscopy and molecular techniques. A total of 80 rat samples which includes rat kidney and urine samples were collected aseptically from urban and rural areas of Mymensingh district. Each sample was allowed to grow initially in the EMJH medium. Identification of the bacterial isolates was done by observing under dark field microscope followed by molecular detection by PCR. It was found that out of 40 rat samples of urban areas 16 were positive (40%) whereas in rural areas 10 rat samples were positive (25%) out of 40. From the both areas, female rat samples were found more positives than male rat samples but more Leptospira were found in adult rat samples than juvenile rat samples. We conclude that Leptospira is circulating among the rat populations of urban and rural areas of Bangladesh and despite the low infection rate reported, the high pathogenicity of some serovars of this organism raises concern of public health risks caused by rat transmission of leptospirosis.

Prevalence of Enterohaemorrhagic *Escherichia coli* O157:H7 and Antimicrobial Susceptibility Profile in Animal-derived Foods

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Abstract
Hemolytic uremic syndrome (HUS) is a risk factor for enterohemorrhagic *Escherichia coli* (EHEC) infections, which also cause bloody diarrhea. EHEC serotype O157:H7 is responsible for worldwide outbreaks of HUS and bloody diarrhea. The aim of this investigation was to ascertain the frequency and resistance to antibiotics of *E. coli* O157:H7 in animal-derived meals. Using cultural, staining, and biochemical traits, a total of 100 samples were gathered and screened for the presence of *E. coli*. The samples included 20 samples of chicken, 20 samples of beef, 20 samples of raw milk, 20 samples of pasteurized milk, and 20 samples of egg washing. Afterwards, a polymerase chain reaction (PCR) using genus-specific 16SrRNA primer was employed to molecularly describe the samples. 38 out of 100 samples tested positive for *E. coli*, according to the investigation. In 40% of the raw milk samples, 10% of the pasteurized milk samples, 60% of the chicken samples, 20% of the beef samples, and 35% of the egg samples, *E. coli* was found. The Stx-1, rfb O157:H7, eae, and hly genes were once more checked by PCR in those 38 positive *E. coli* samples. Based on the results, the 2(5.26) isolate was found to have a positive Stx-1 gene and a confirmed positive rfb O157:H7 gene. The antimicrobial susceptibility pattern of Enterohaemorrhagic *Escherichia coli* O157:H7 against ten commonly used antimicrobial agents was found through the utilization of the disc diffusion method. Ciprofloxacin, Gentamicin, Azithromycin, and Kanamycin showed the strongest patterns of sensitivity among them, whilst Cephalexin and Nalidixic acid showed moderate sensitivity. It was found that every isolate was resistant to erythromycin, ampicillin, amoxicillin, and cefixime. The significance of establishing trustworthy biosecurity procedures throughout the food supply chain is highlighted by these findings.

Antibiohgram Profiling and Detection of *icaA* and *blaZ* Genes from *Staphylococcus aureus* and Coagulase Negative *Staphylococcus* spp. of Healthy Bovine Raw Milk Sample Origin

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Abstract
This study focused on the antibiogram profiling of *S. aureus* and coagulase negative *Staphylococcus* spp. (CoNS) and the detection of *icaA* and *blaZ* genes from bovine raw milk samples. Bovine milk samples were collected from dairy farms and *Staphylococcus* spp. were isolated and identified via conventional and molecular screening. Disk diffusion test (DDT) was implemented to determine resistance pattern. Biofilm and β-lactamase-producing *Staphylococcus* spp. were identified via amplification of *icaA* and *blaZ* genes. Methicillin-resistant *S. aureus* (MRSA) and CoNS were identified by DDT and PCR of *mecA* gene. From 63 samples, 35 were confirmed as *Staphylococcus* spp., of which 16 (25.39%), *S. aureus* isolates were coagulase-positive, while 19 (30.16%) were negative. PCR confirmed that 50% (8/16) of *S. aureus* and 36.84% (7/19) of CoNS possessed the *icaA gene*. All *S. aureus* isolates were found resistant to Penicillin-G both phenotypically and genotypically. The isolates were also resistant to Erythromycin, and Oxytetracycline. While, CoNS showed high to reduced resistance against Penicillin-G, Oxytetracycline, Erythromycin, and Azithromycin. No *S. aureus* isolates were resistant to Sulfamethoxazole, while 10.53% of CoNS isolates were. All *S. aureus* and CoNS isolates were susceptible to Vancomycin and Gentamicin. Methicillin resistance was exhibited by 37.5% of *S. aureus* and 42.10% of CoNS isolates. Moreover, *S. aureus* and CoNS had 56.25% and 52.63% multidrug resistant isolates, respectively. Present study revealed the presence of biofilm producing multidrug resistant staphylococcal strain in milk, that might endanger consumers. Routine surveillance and monitoring alongside antimicrobial resistance learning can reduce risks.

Isolation, Phenotypic and Genotypic Characterization of Novel Lytic Bacteriophage BAU.Micro_ELP-22 against Avian Pathogenic *E. coli* O157:H7 Strain for Safe Poultry Production

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Abstract
Antimicrobial resistance is a concerning global public health threat for over years. Worldwide much attentions have been drawn for fighting this devastating crisis. Phage therapy is a new hope to combat against antibiotic resistance. *E. coli* O157:H7 is a pathogenic bacterial strain associated with colibacillosis causes septicemia, perihepatitis, pericarditis and ultimately huge economic losses in poultry industries. Applying bacteriophage therapy as an alternative option of antibiotics is a prominent step to cope with the crisis. In this study a novel lytic bacteriophage BAU.Micro_ELP-22 was isolated from sewage water as a potential antibacterial bio agent against *E. coli* O157:H7 strain and was characterized by *in vivo* and *in vitro* approaches. The phage exhibited a broad host lytic activity, remarkable thermal stability from 0°C to 60°C and pH survivability from 4 to ≥ 9. According to one step growth curve analysis, the isolated phage has relatively shorter latent period of < 25 min and larger burst size of >250 PFU, which indicates it's strong lytic activity. The phage BAU.Micro_ELP-22 exhibited strong antibacterial activity against *E. coli* O157:H7 by *invitro* antibacterial activity investigation on the basis of OD value determination. No toxicity was observed in case of toxicity investigation test as the phage was injected into BALB/c mice model. More over in vivo efficacy test of the isolated phage revealed the successful recovery report of the *E. coli* O157:H7 infected experimental mice by the phage treatment. From Next generation sequencing (NGS) of the bacteriophage analysis data, the double stranded phage DNA length is 4,92,709 bp which contains 35.5% GC content and 858 coding sequences and does not contain any toxin producing or virulent gene. All the findings suggest that, BAU.Micro_ELP-22 is a potential candidate for phage therapy against *E. coli* O157:H7 strain to combat against colibacillosis as well as antibiotic resistance for safe poultry production.

Phenotypic Characterization and Whole Genome Analysis of Bacteriophage BAU. Micro_SLP-22 Against Multidrug Resistant Avian *Salmonella* spp.

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Abstract
Multidrug resistant (MDR) *Salmonella* spp. associated with Salmonellosis causes huge economic losses in poultry industries. Applying bacteriophage therapy as an alternative option of antibiotics is a prominent step to cope with the crisis. In this study a novel lytic bacteriophage BAU.Micro_SLP-22 was isolated from sewage water as a therapeutic agent against MDR *Salmonella* spp. and was characterized by *in vivo* and *in vitro* approaches. The phage exhibited a broad host lytic activity, remarkable thermal stability from 0°C to 60°C and pH survivability from 4 to ≥ 9. According to one step growth curve analysis, the isolated phage has relatively shorter latent period of < 20 min and larger burst size of >300 PFU, which indicates it's strong lytic activity. The phage BAU.Micro_SLP-22 exhibited strong antibacterial activity against *Salmonella spp.*by *in vitro* antibacterial activity investigation. No toxicity was observed in case of toxicity investigation test as the phage was injected into BALB/c mice model. More over in vivo efficacy test of the isolated phage revealed the successful recovery report of the *Salmonella* spp. infected experimental mice by the phage treatment. From Next generation sequencing (NGS) analysis data, the double stranded phage DNA length is 2,42,090 bp which contains 51% GC content and 373 coding sequences and does not contain any toxin producing or virulent gene. All the findings suggest that, BAU.Micro_SLP-22 is a potential candidate for phage therapy against MDR *Salmonella spp.* to combat against Salmonellosis as well as antibiotic resistance.

Polyvalent Mastitis Vaccine Development to Prevent Mastitis in Dairy Cow

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Abstract
Introduction: Mastitis is frequently found in lactating cows worldwide, including in Bangladesh. This study was carmel Mastiti develop a polyvalent mastitis vaccine to prevent mastitis imitating cows and reduce the indiscriminate use of antibiotics in dairy farming. Methods: Mastitis-affected cow milk was collected from randomly selected cows after being confirmed by the California Mastitis Test, and then the samples were allowed to undergo a somatic cell count (SCC) by LactoScan Combo. Afterward, SCC-positive milk samples were inoculated on selective growth media, incubated at 37°C, subcultured, and confirmed by PCR and MALDI ToF MS. Through PCR and MALDI-TOF MS detection, it was found that 54.79% of the mastitis-positive cows were infected by Staphylococcus aureus, 37.56% by Escherichia coli, 2.12% by Streptococcus agalectiae, and 4.76% by Streptococcus uberis; the isolates are multidrug-resistant and zoonotic in nature. Findings: In the WGS analysis, it was found that the isolates carried many antibiotic efflux, antibiotic target alteration and virulent genes. A polyvalent mastitis vaccine was prepared using S. aureus, E. coli, S. agaclactiae, and S. uberis in a water-in-oil-in-water adjuvant. The vaccine is safe for pregnant and lactating cows. Conclusion: The newly developed polyvalent mastitis vaccine prevents mastitis in lactating cows, would be beneficial to combat multidrug-resistant mastitis-causing pathogenic infection, minimize public health threats, and economically help the dairy farmers of Bangladesh

Development of Lowcost Inactivated and Live Attenuated Duck Plgue Vaccines Using Local Duck Plague Virus

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Abstract

Duck plague (DP) is one of the most important viral diseases of Ducks.That belongs to the Anatid Herpes Virus; the Herpesviridae family is an acute and highly infectious duck, geese, and swan disease that causes tremendous economic losses of duck rearing farmers in Bangladesh and other countries This research was aim to isolate DPV from recent field's outbreaks and performed molecular detection and phylogenetic analysis. For this purpose, 60 samples were collected from the Netrokona (n=37) and Mymensingh (n=23) districts. Suspected organs were collected by post-mortem examination and transported to the Molecular Microbiology Laboratory (MML) in the Department of Microbiology and Hygiene, BAU using Virus transportation media (VTM) in cool box. After transportation inoculum was prepared and DNA extracted using viral DNA extraction kit (Favorgen, Tiwan). UL gene and DNA polymerase gene of DPV was targeted by Polymerase chain reaction (PCR) amplification. PCR positive DPV was inoculated into 9-11 old days Embryonated Duck Eggs (EDE) through Chorioallantoic membrane (CAM) route and confirmed by PCR. Out of 60 samples tested by PCR, 20 (33.33%) were found positive for Duck Plague Virus (DPV). Molecular characterization was performed from extracted DNA of duckling and 5 Positive PCR products were partially sequenced for phylogenetic analysis of their origin and nucleotide variations. Sequenced data was analyzed to reveal genetic relationships among constructed phylogenetic tree for understanding potential transmission with origin of virus and data was then submitted to gene bank. Therefore, this has found that recent isolates have similarity with Bangladesh, India and China. Duck plague is very emerging disease for duck. So farmers need reliable and cost effective vaccine. this is why further study is needed for developed effective vaccine against Duck Plague disease.

Isolation and Molecular Characterization of Inclusion Body Hepatitis Virus from Recent Field Outbreaks for the Development of Inactivated Vaccine

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Abstract

Inclusion body hepatitis (IBH) is an acute liver disease of young broiler chickens caused by the IBH virus of the Fowl adenovirus (FAdV) family. IBH is an acute disease of young chickens caused by several serotypes of Fowl adenoviruses (FAdVs). Recently, an investigation on causes of sudden mortality, lower growth, and higher FCR in commercial broilers was reported by Saleq in 2020. IBH is characterized by sudden onset high mortality up to 80% with clinical signs (yellowish diarrhea, weight loss, lethargy, decreased appetite, and pale comb); and necropsy signs like pale, friable, swollen liver with necrosis and large basophilic intra-nuclear inclusion bodies. IBH mainly affects broilers up to 5 weeks of age and it causes tremendous financial losses because there is no corrective measure that can be taken if the symptoms are exposed. We conducted a limited study in our Lab. and confirmed the IBH virus in broiler farms in Trishal, Mymensinh. A total of forty (40) IBH suspected dead and sick birds were collected from farms in the Netrokona, Gazipur, and Mymensingh districts. By postmortem examination, visceral organs (Lung, Heart, and Liver) were collected. Out of 80 samples, 6 samples of Netrokona, 12 samples from Gazipur, and 12 samples of Mymensingh were confirmed as positive by PCR using DNA polymerase gene-specific primers of 564 bp. Partial sequence of Hexon gene and polymerase genes were performed and we obtained GenBank Acession No. as FAdV/Trishal/Bangladesh/01/2022 OP688506 (hexongene), FAdV/Trishal/Bangladesh/02/2022 OP688507 (hexon gene), FAdV/Trishal/Bangladesh/03/2022 OP688508 (hexon gene), FAdV/Trishal/Bangladesh/01/2022 OP688509 (Pol. gene), FAdV/Trishal/Bangladesh/02/2022 OP688510 (Pol. gene), FAdV/Trishal/Bangladesh/ 03/2022 OP688511 (Pol. gene). It is very important to develop an inactivated IBH vaccine from local IBH virus isolates.

Development of Attenuated Fowl Pox Vaccine from Field Isolates of Fowl Pox Virus

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Abstract

Fowl pox is characterized by proliferative and nodular lesions on featherless skin or fibro necrotic and proliferating areas in the mouth, esophagus, and upper respiratory tract mucous membrane of poultry. The aim of this research was to investigate molecular and evolutionary characteristics of Fowl pox virus (FPV) isolated from recent outbreaks in chickens in Mymensingh and Netrakona districts. This study samples were collected from nodular lesions of featherless part of chickens and transported to the Molecular Microbiology Laboratory (MML) in the Department of Microbiology and Hygiene, BAU using Virus transportation media (VTM) in cool box. After transportation inoculum was prepared and DNA extracted using viral DNA extraction kit (Favorgen, Tiwan). P4b gene of FPV was targeted by Polymerase chain reaction (PCR) amplification. PCR positive FPV was propagated into 9-11 days chicken eggs through chorioallantoic membrane (CAM) route and re-confirmed by PCR. Out of 40 samples tested by PCR, 12 (30%) were found positive for Fowl pox virus (FPV). Partial sequencing of P4b gene of 03 FPV has been completed. Phylogenetic analysis of partial P4b gene Sequence revealed that the Mymensingh and Netrakona FPV isolates were 99.65 – 100% identical to each other and 99 – 100% identical to several published sequences of FPV isolates from various countries in different continents of the world, including Europe and Asia. It may be concluded that FPV is circulating in layer farm and young chicks in Mymensingh and Netrakona districts.

Antimicrobial Resistance in Enterobacteriaceae Isolated from Food and Food-Producing Animals

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Abstract

Antimicrobial resistance (AMR) is a global health crisis. Carbapenems are a reserve group of antibiotic. They are last resort to fight against many multidrug resistant pathogens including colistin resistant and ESBL producing enterobacteriacea. Carbapenem-resistant Enterobacteriaceae (CRE) in food and food-producing animals are major public health concerns globally. In this study, we analyzed 275 samples of food and food-producing animal origin for the detection of the resistance pattern of Enterobacteriaceae to carbapenems and other antibiotics. Food samples analyzed included 16 fruits, 34 vegetables, and 102 seafood. Animal samples were fecal materials of cattle (51), broilers (36), and Sonali chicken (36). Isolation and identification of members of Enterobacteriaceae, *i.e., E. coli, Salmonella* spp. *Shigella* spp. and *Klebsiella* spp. were based on culture, staining, biochemical tests, and PCR. Antibiotic sensitivity test was performed by disk diffusion test. The double disk synergy test (DDST) was performed to detect extended-spectrum beta-lactamase (ESBL)-producing *E. coli*. Among all the samples, 149 were found positive for *E. coli*, three for *Salmonella* spp., four for *Shigella* spp., and three for *Klebsiella* spp. In the disk diffusion test, all the isolates were found sensitive to the carbapenem group of antibiotics *i.e.*, imipenem, meropenem, doripenem, and ertapenem. On the sample basis, 20% of *E. coli* isolated from vegetables and 9.3% isolated from seafood were resistant to tetracycline. Eight (18.6%) *E. coli* of seafood origin were ESBL producers. Present findings suggest that food and samples from food-producing animal origin analyzed in this study are free of CRE, but carries other resistant isolates. Further studies are required comprising more samples to reveal the actual status of CRE in foods.

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Pathotypical and Genotypical Characterization of Strains of Newcastle Disease Virus Isolated from Outbreaks in Chickens Flocks in some Regions of Bangladesh

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Abstract
Newcastle disease virus (NDV) is endemic in Bangladesh and is a major threat to commercial poultry operations. It is a contagious viral disease affecting birds throughout the world and causing economic losses in the poultry industry. The present research work was carried out to isolate and identify Newcastle disease virus (NDV) by using haemagglutination (HA) test and reverse transcription-polymerase chain reaction (RT-PCR) using primers of Fusion (F) and Matrix (M) genes. A total of 12 samples (Brain, trachea, proventiculus) were collected from 4 clinically ND suspected dead birds through post-mortem examination from Trishal and Mymensingh sadar. All the samples were inoculated onto 10-day-old embryonated chicken eggs through chorio-allantoic membrane route. The allantoic fluid (AF) of the dead embryos harvested at 48 and 96 hours of post-infection. Total 04 isolates were identified by HA and chicken embryo inoculation after obtaining samples through post mortem examination. RT-PCR have been performed using the primers for partial amplification of F (839bp) and M (970bp) genes through which all 04 isolates were confirmed as NDV. For PCR amplification of a 970 bp fragment spanning nt 1161 of the M gene through nt 889 of F gene, whereas for amplifying the 839 bp fragment covering nt 862 through 1700 of F gene, were used. Pathotypic characterization of all NDV field isolates revealed that all isolates were velogenic (MDT: <60, ICPI: 1.5-2.0). Genotypic characterization revealed that the isolates may be of Genotype VII according to phylogenetic analysis of 'F' and 'M' genes partial sequencing data. Immune response study using the NDV field isolate showed better immune response. Therefore, velogenic strains of NDV which is mostly prevalent in field level in Bangladesh can be used as potential candidate for killed vaccine development.

Analysis of Bovine Viral Diarrhea Virus Antigen Status in Milk and Serum Samples: Implications for Effective Screening and Risk Factors in Dairy Cows

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Abstract
Bovine viral diarrhea virus (BVDV) is a significant viral pathogen affecting cow populations worldwide. This study, conducted in the Baghabari area of Sirajganj District, Bangladesh, investigates the prevalence of BVDV antigen in 54 dairy cattle exhibiting reproductive, milk production, and congenital abnormalities. Milk and blood samples were collected from cows with no history of BVDV vaccination. The research employs indirect enzyme-linked immunosorbent assay (ELISA) to detect viral antigen and the results reveal a significant discrepancy in BVDV antigen positivity between milk (55.56%) and serum (92.60%) samples from the same animals. Unexpectedly, animals negative in one sample type tested positive in the other, indicating potential localized viral presence or shedding variations. ELISA titers also differed between serum and milk samples, raising questions about viral dynamics within bodily fluids. Risk factor analysis explores associations with age, pregnancy, and decreased milk production. Older and pregnant cows exhibit higher BVDV positivity. Surprisingly, no clear correlation is found between decreased milk production and BVDV persistence. Congenital defects in cows do not appear strongly linked to BVDV positivity. In conclusion, this study advocates a comprehensive testing approach involving both serum and milk samples for effective BVDV screening. The observed discrepancies highlight the need for further research into viral dynamics and their influence on various risk factors in dairy cows.

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Molecular Epidemiology of Hepatitis B virus and Mutational Analysis of Small HBsAg in Clinically Infected Patients in Mymensingh Region

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Abstract

Developing nations such as Bangladesh are facing a serious threat from hepatitis B virus (HBV) infection. Furthermore, mutations in the HBV genome may result in vaccine and diagnosis evasion, treatment failure, and ultimately, increased disease severity. Thus, the study was designed to identify drug-resistant and HBsAg escape mutations, as well as to investigate the molecular epidemiology of HBV in the Mymensingh region. Blood samples (n=136) along with sociodemographic data were collected from clinically infected patients to conduct ICT, ELISA, DNA extraction followed by quantitative PCR (qPCR), PCR, sequencing, and analysis of the small HBsAg gene. Both ICT and ELISA confirmed 100% HBsAg positivity, while only 88.24% of the samples tested positive for HBV DNA by PCR and qPCR. Additionally, there was a significant correlation between viral load and HBsAg titer ($p<0.001$, $r=0.98$). Amplification, sequencing, and analysis of 15 small HBsAg coding regions revealed genotype C (93.33%) and genotype A (6.67%), significantly associated ($p=0.008$) with serotypes adr and adw2, respectively. According to the phylogenetic tree, the study isolates were evolutionarily related to isolates from Bangladesh, China, Malaysia, and Indonesia. Mutations associated with a high risk of HCC and antiviral drug resistance against lamivudine, adefovir, entecavir, and telbivudine were found. However, no tenofovir-resistant mutations were detected. Moreover, patients infected with drug-resistant mutant viruses had a significantly higher viral load ($p=0.001$). These results will illuminate the current molecular epidemiological status of HBV infection in the Mymensingh region and assist in developing more effective disease management strategies.

Antimicrobial Resistance and Virulence Profiles of Extended-spectrum β-lactamase-producing *Escherichia coli* Isolates in Milk Samples of Dairy Cows in Bangladesh

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Abstract

E. coli is one of the major food-borne bacterial pathogens worldwide. The emergence of antimicrobial-resistant *E. coli* in milk is a serious public health concern. It is considered that, milk is the single most complete food of nature due to presence of high nutritive contents, which in turn makes it an ideal medium for the rapid multiplication of bacteria, particularly under unhygienic production and storage at ambient temperatures. This study is aimed to isolate and identify ESBL-producing *E. coli*, antimicrobial resistance pattern and detection of ESBL producing genes and various virulent genes from milk samples from healthy cows in smallholder dairy farms in Mymensingh district, Bangladesh. A total of 130 milk samples were collected from apparently healthy cows on smallholder dairy farms. Following standard procedure, *E. coli* was isolated from the collected samples. The detection of ESBL producing E. coli was performed phenotypically by disc diffusion method and genotypically by ESBL genetic determinants using conventional polymerase chain reaction. Out of 130 samples tested, 98 (75.38%) samples showed bacterial growth, among which 56 (57.14%) isolates were identified as E. coli. Among these, 13 (23.21%) strains were identified as ESBL-producing both phenotypically and genotypically with the presence of *TEM*, *SHV* and *CTX-M* genes individually or combination. 57.14%, 5.36% and 8.93% E. coli were positive for *fimH*, *sfa* and *papC* virulent genes, respectively. The antibiogram showed 98.21%, 80.36%, 53.57% and 30.36% resistant to Ampicillin, Cefoxitin, Amoxyclave and Gentamicin, respectively. The detection of MDR ESBL-*E. coli* suggests that dairy cattle can be a reservoir for the bacteria, highlighting the associated public health risk.

Detection and Characterization of Fluoroquinolone-resistant *E. coli* from Local Country Birds

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Abstract
Antimicrobial resistance is a global health crisis. Local country birds namely Shalik, Crow, and Sparrow are quite common in Bangladesh all year round. These birds could be potential sources for fluoroquinolone-resistant *E. coli*. A total of freshly dropped fecal 134 samples were collected for analysis. Isolation and identification of *E. coli* was based on culture followed by PCR. Antibiograms were determined by a disk diffusion test. The presence of resistance genes was determined by PCR. About 83% of the local country birds were found positive for *E. coli* in their fecal samples. In the antibiogram study about 16 to 40% isolates were found resistant to different types of fluoroquinolones. Fluoroquinolone-resistant gene *qnrA* was detected in 45% of isolates. None of the isolates were found positive for the *qnrS* gene. In addition, tested all the isolates were found resistant to ampicillin and ceftazidime. To the best of our knowledge this is the first study in Bangladesh describing molecular detection of fluoroquinolone-resistant *E. coli* from local country birds. Our findings suggest that Shalik, Crow, and Sparrow could be a potential source for the spread of fluoroquinolone-resistant *E. coli* in the environment.

Resistance Pattern of *Escherichia coli* and Soil Microbial Communities in Rooftop and Surface Garden of Urban and Peri-urban Origin

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Abstract
E. coli is one of the most prevalent foodborne pathogens. Current study focused on isolating *E. coli* from raw vegetables, soil, and water from rooftops and surface gardens, as well as determining their antibiogram. This study employed 145 different raw vegetable samples, including brinjal, coriander leaves, Bengal spinach, chili, bitter gourd, carrots, potato, bean, cabbage, cucumber, radish, and many more, from rooftop and surface gardens in Dhaka North city, Dhaka South city, and Gazipur district. *E. coli* was detected in 85 of 145 samples. Among them 54 isolates were subjected to antibiogram. 73 rooftop samples 34(46.57%) and 72 surface samples 51 (70.83%) of 145 samples obtained from Dhaka North, Dhaka South, and Gazipur were verified to be *E.coli* positive, which was 24.26% higher in the case of the surface garden than the rooftop garden. The 54 isolates chosen at random for the antibiogram investigation by disk diffusion test against 11 antibiotics. All isolates tested positive for ampicillin resistance. In addition to ampicillin, 25.92% of *E. coli* isolates were resistant to ciprofloxacin, 14.81% to tetracycline and co-trimoxazole, 9.25% to imipenem, and sensitive to ciprofloxacin (74.07%), imipenem (37.03%) etc. All, 54 isolates were MDR. The *blaTEM* genes that produce beta-lactamase were identified in 44 (81.48%) of the isolates. Tetracycline resistance *tetA* genes were also discovered in 2 (3.70%). Whole genome analysis also detected occurrence of resistance and virulence genes in isolated *E. coli* suggesting these to be considered as potential health hazard. In addition, we also did metagenomic analysis of soil microbial communities. Our data provided evidence for the existence of both unique and shared microbiomes in the soil samples of both rooftop and surface gardens, which might be taken into consideration for undertaking future microbiome study in this economically important agriculture sector.

Isolation and Characterization of Emerging Infectious and Trans-boundary Viral Diseases of Poultry and their Control Strategies

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Abstract
A total no. of 424 samples were collected randomly from the dead and sick birds (commercial layer and broiler) of 10 different outbreak districts with a view to isolate and identify the AIV, NDV and IBHV. Of the 424 samples 192 were for suspected AIV and 168 for NDV and 64 for IBHV. Out of 192 AIV suspected samples 80 were found positive as AIV by rapid AIV kit and 40 by qRT-PCR. Of the 40 qRT-PCR positive H9N2 samples 25 (62.5%) were found positive for isolation of H9N2. Of the total 168 ND suspected field samples 65 were found positive by rapid kit, qRT-PCR and RT-PCR. Out of 65 RT-PCR positive samples 28 (43%) were positive for virus isolation in avian embryos. Only 3 isolates were subjected to sequences analysis for F gene. Out of 64 IBH suspected poultry samples 34 (53%) were positive as IBHV by iiPCR and PCR and 22 (64.7%) out of 34 PCR positive samples were found positive for isolation and 5 out of 22 (22.7%) were subjected to partial nt sequences of the hexon gene of the recent isolates of IBHV. One of the three isolates of NDV (GVII) was selected as a candidate for the experimental development of inactivated vaccines to determine the immunogenicity to the field isolates in commercial poultry.

The Effects of Gestational Exposure to the Food Additive Potassium Bromate on Reproductive and Immunological Parameters in Offspring Mice

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Abstract
Potassium bromate ($KBrO_3$) is a member of the bromides group and a strong oxidizing agent. It has been used as a food additive. $KBrO_3$ was reported as carcinogenic and mutagenic effects. The research investigated the effects of maternal exposed $KBrO_3$ on the growth, reproductive performance and immune cells in parental mice and their F1 generation offspring mice. A total of 30 Swiss Albino mice (*Mus musculus*) (10 male and 20 female) age of 25-28 days were collected from ICDDR'B, Dhaka and at the age 45 days, mice were randomly divided into 2 groups each containing 15 mice of 5 male and 10 female. The group A served as vehicle control, while group B provided $KBrO_3$ @ 400 mg/liter drinking water. Body weights were taken at 2 weeks intervals. The results showed that $KBrO_3$ caused the retarded growth in both male and female parental mice. Estradiol, testosterone and T4 values were significantly ($p<0.01$) decreased in $KBrO_3$ treated mice. A significant ($p<0.05$) reduction in the sperm count and sperm motility was observed in $KBrO_3$ treated mice. The seminiferous tubules of the testis of $KBrO_3$-treated groups showed moderate degenerative changes. All female mice were successfully conceived, but mice treated with $KBrO_3$ took a longer time to get conceived and delivered the lower number of pups compared to the control group. $KBrO_3$-treated offspring mice had less body weight. Their body weights were slowly increasing. Neutrophils numbers were slightly increased in mice born from $KBrO_3$ treated group. F1 offspring mice of $KBrO_3$ -treated group had lower sperm count, sperm motility and testis weight ($p<0.05$). Testosterone and estradiol concentrations in F1 mice were lower in $KBrO_3$ treated group compared to F1 mice of control group. This study concludes that $KBrO_3$ may have multigenerational effects on growth and reproduction. More research on $KBrO_3$ is needed to draw a final conclusion and find out the exact mechanism of it.

Multigenerational Effects of Environmental Contaminant Phthalate Plasticizers on Reproductive Health in Goats

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Abstract
The impact of various environmental factors on human and animal reproductive health is a big concern. Phthalates, Bisphenol A, heavy metals and industrious sludge are common environmental contaminants. Phthalate plasticizers are widely used in common consumer products, including various plastics, cosmetics, personal care products, children toys, plastic medical devices, processed foods, insecticide formulation and high-fat dairy and meats. They have an effect on the reproduction of small ruminants, causing abortion, delayed estrus, and decreased fertility. The research work investigated the impact of dietary exposure to a phthalate mixture on physical and hemato-biochemical parameters in pregnant Black Bengal (BB) goats and their impacts on F1 offspring goats. A total of 20 clinically healthy, 1–2 months pregnant, aged 6–8 months with a body weight of 10–12 kg BB goats were collected and divided into two (n = 10) groups. The treatment group received a standard goat ration with a combination of different phthalates mixture while the control group was provided the same ration with the vehicle of a phthalate mixture until parturition. The physical parameters were measured with appropriate tools and blood samples were collected for hemato-biochemical tests. The results showed that body condition score, respiration rate and heart rate were significantly ($P < 0.05$) reduced in phthalate-exposed goats. The hematological parameters: RBC count, WBC count, hemoglobin concentration, hematocrit values and RBC indices were significantly ($P < 0.05$) lower in phthalate-exposed goats. Phthalate-exposed BB goats had significantly ($P < 0.05$) higher neutrophil and lower lymphocyte counts. Serum glucose, total protein, albumin and total cholesterol levels were significantly ($P < 0.05$) lower in phthalate-exposed BB goats but higher the values of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and blood urea nitrogen (BUN) levels in treated BB goats. The effects on reproductive parameters in the offspring goats are currently investigating. Maternal exposure to phthalate mixtures may affect the reproductive system in offspring.

Transgenerational Effects of Environmentally Relevant Phthalate Plasticizer and Thymoquinone on Reproductive and Immunological Parameters in Mice

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Abstract
Phthalates (PHA) are environmental pollutants, widely used in the plastic industry. Exposure to PHA is known to have detrimental effects on human and animal health. Thymoquinone (TQ), a bioactive constituent of the black cumin seed, holds promising pharmacological properties against several diseases. The research work is carrying out to evaluate the effects of TQ on reproductive and immunological parameters in PHA treated Swiss albino mice at the multigenerational level. A total of thirty mice of 28-30 days of age were used and divided into three groups consisting of 10 mice (6 female and 4 male) in each. Group A (control) was fed normal mice pellet mixed with olive oil, group B was fed with PHA and group C was administered both TQ and PHA mixed with mice pellet. All mice were administered PHA and TQ at the later stages of pregnancy and reared at 26-30ºC until parturition. Blood, sera & organ were collected and processed from parental (F0) mice according to standard methods. F1 offspring mice were reared naturally. Results revealed that PHA caused an increase in body weight gain in F0 male mice. Receiving TQ with PHA normalized the body weight. Serum T4 and testosterone concentration were significantly ($p<0.01$) decreased in the PHA treated F0 male mice whereas TQ caused improvement of these two hormones. PHA caused a significant ($p<0.01$) reduction in the sperm count and sperm motility with increased abnormalities whereas TQ prevented these sperm parameters. There were degenerative and necrotic changes found in the seminiferous tubules in the testis of PHA treated F0 male mice only. Body weight, Reproductive and

immunological parameters were altered in PHA treated in F1 and F2 male mice whereas TQ decreased those values. PHA altered sperm physiological parameters significantly (P<0.01) in F1 and F2 mice while TQ restored sperm motility & concentration. It is concluded that PHA has harmful effects on reproductive parameters at the multigenerational levels. These harmful effects could be alleviated by the addition of TQ.

Mitigating Action of Coral Fossil against Mycotoxin Infection in Birds

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Abstract

Mycotoxins are toxic secondary metabolites of fungi commonly found on grains, which cause severe impacts on animal health and performance. Coral fossil can remove toxic substances; it contains calcium, magnesium and more than 70 kinds of minerals and works for antibacterial, fungistatic, and antioxidative action. So, the aim of the study is to evaluate the actions of coral fossil as a toxin binder for removing the harmful effects of aflatoxin in broiler. For this study, the 80 broilers were divided into 04 groups each containing 20 broilers. Group A was served as vehicle control and received daily doses of the poultry feed. Groups B was supplied with 1 gm coral fossil/kg body weight. The birds in Group C received 200 ppb of aflatoxin B_1. Groups D was administered with 200 ppb of aflatoxin B_1+1 gm coral fossil/kg body weight. Both the aflatoxin and coral fossil were given with water. The experiment was carried out for 30 days. After sacrifice, blood was collected and serum was prepared. The results showed that total leukocyte count was decreased significantly ($p<0.05$) in mycotoxin treated broilers but increased significantly ($p<0.05$) after coral fossil treatment while there were no significant changes in total erythrocyte count and hemoglobin concentration after both treatments. Liver and kidney enzymes in mycotoxin treated broilers were increased significantly ($p<0.05$) but decreased significantly ($p<0.05$) after coral fossil supplementation. Therefore, it can be concluded that coral fossil supplementation has protective effects on mycotoxin treated broilers.

Reproductive Health Benefits of *Nigella Sativa* Oil on Chronic Lead Exposed Male Rats

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Abstract

Lead (Pb) is a highly toxic heavy metal that can cause harm at extremely low concentrations and damage various organs. *Nigella sativa* oil (NSO) mitigates these adverse effects by regulating antioxidant enzymes like glutathione peroxidase, glutathione-S-transferase, and acting as a scavenger for reactive oxygen species in different organs. The primary objective of this research was to investigate the potential benefits of NSO on male rats exposed to chronic Pb toxicity, particularly in terms of their reproductive health. The 60-male albino wistar rats were divided into four groups and 15 in each: a control group, a group exposed to 1.5% Pb, a group given NSO (1ml/kg feed), and a group exposed to 1.5% Pb along with NSO (1ml/kg feed). Pb was administered through water, while NSO was incorporated into their feed over a period of four months. The findings indicated a significant decrease in serum concentrations of T_4 and testosterone in rats exposed to Pb, whereas NSO demonstrated a remarkable ability to restore these hormone levels. Moreover, Pb exposure led to a notable reduction in sperm motility, sperm concentration, testis weight, and testis diameter, accompanied by seminiferous tubule degeneration. However, the administration of NSO effectively counteracted the adverse effects induced by chronic Pb exposure in rats. So, It can be concluded that the consumption of NSO has shown great promise in preserving the reproductive function of male rats exposed to chronic Pb toxicity.

Evaluation of the Potency of Coral Fossil as a Toxin Binder in Blood Biochemistry and Different Organs in Heavy Metal Treated Broiler

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Abstract
Heavy metals are persistent in the environment and cause bioaccumulation in the food chain. Coral fossil (CF) is a potential source of hydrogen rich calcium that acts as a toxin binder. Coral fossil (CF) acts as a toxin binder, yet limited knowledge is available on impacts of CF on pb and Cd toxicities. The experiment was carried out with 50 broilers and were divided into 05 groups containing 10 broilers in each. Group A was served as vehicle control. The birds in group B and C were received daily doses of Pb (280 mg /kg body weight (b.w.)) and Cd（75 mg/kg b.w) respectively. Whereas group D was supplemented with Pb (280 mg /kg b.w) + coral fossil (1 gm/kg b.w). Group E was received Cd（75 mg/kg b.w) + coral fossil（1 gm/kg b.w). After sacrifice, blood was collected and serum was prepared and organs were collected. Liver, kidney and muscle were collected to assess accumulation concentration. Brain, liver and kidney were collected and processed for histopathological study. The results revealed that Pb and Cd accumulation was higher in liver, kidney and muscle tissue that was reduced by coral fossil treatment. Liver and kidney enzymes in Pb and Cd treated broilers were increased significantly ($p<0.05$) but decreased significantly ($p<0.05$) after coral fossil supplementation. The histopathological study demonstrated that there was accumulation of fluid around blood vessels of brain, hyperplasia of bile duct and glomerular epithelium in lead intoxicated broilers. Cd treated broilers showed focal degenerative changes in the blood vessel of brain, proliferation of renal tubular epithelium with degeneration and necrosis but the liver was normal. All the histotexture alterations were improved after coral fossil supplementation. Therefore, it can be concluded that coral fossil supplementation has prophylactic effects on specific organs in Pb and Cd treated broilers.

Role of Vitamin-C on Acrylamide Induced Reproductive Toxicity in Male Mice

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Abstract
The study was carried out to investigate the effect of Vitamin C against Acrylamide (ACR) toxicity on body weight, length and weight of testes and epididymis, haemato-biochemical parameters, abnormalities of sperm and histopathological changes of testes, epididymis and prostate gland in male mice. A Total of 40 male Swiss Albino mice (*Mus musculus*), aged 25-28 days were randomly divided into 4 groups (n=10) such as Control group (group A), ACR treated group (group B), Vitamin C treated group (group C), ACR plus Vitamin C treated group (group D), Vitamin C treated group Results revealed that ACR caused a decrease in body weight, a decrease in length and weight of testes and epididymis, alterations in hematological parameters (TEC, Hb, PCV, and Erythrocyte Indices), and changes in lipid profile (TC, TG, HDL, LDL) in mice. Supplement of Vitamin C along with ACR improved the altered values. Serum testosterone concentration was significantly ($p<0.01$) decreased in ACR-treated mice whereas, Vitamin C dramatically retained the level of testosterone. In parallel to the effect of ACR on testosterone, there was a reduction in the sperm count and sperm motility percentage along with head and tail abnormalities in ACR-treated male mice. Whereas Vitamin C restored the abnormalities of sperm. Histopathological analysis of testes demonstrated that there was arrest of spermatogenesis characterized by only spermatogonium containing seminiferous tubules and dilatation of inter-tubular spaces in testes. In epididymis, there was disarrangement of the epithelial structure of small-sized tubules lacking sperm. It can be concluded from this study that ACR has harmful effects on growth performance, hematology, lipid profile, hormonal assay, sperm physiology, and histology of testes, epididymis, and prostate gland. These detrimental effects of ACR could be alleviated by the supplementation of Vitamin C.

Protective Potentiality of Blue-green Algae (*Spirulina platensis*) as Natural Antioxidant in the Mitigation of Cadmium Induced Oxidative Stress in Broiler Chicken

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Abstract

Poultry feed may be contaminated by the environmental heavy metal cadmium (Cd) due to its presence in concentrates and supplements. Recently, there has been a great demand for new natural sources of antioxidants to prevent oxidative damage to living cells and reduce food destruction by heavy metals. This study aims to evaluate the efficacy of *Spirulina platensis* as a natural antioxidant against oxidative damage, growth performance, tissue residues, carcass and meat quality, and biochemical and histopathological alterations induced by Cd in broiler chickens. A total of 80 day-one-old broiler chicks were purchased and divided into six groups. Then, they were supplied with Cd at 75 mg/kg bwt, Spirulina at 1 g/kg bwt, Spirulina at 2 g/kg bwt, Cd at 75 mg/kg bwt with Spirulina at 1 g/kg bwt, and Cd at 75 mg/kg bwt with Spirulina at 2 g/kg bwt for 5 weeks. Body weight was recorded weekly to see the feed conversion ratio and growth performance. After 5 weeks, all birds were sacrificed. Blood samples were used for the hematological (Hb, PCV, TC, DC) study, and serum samples were used for the biochemical study. Internal organs such as the liver, kidney, spleen, and breast muscles were collected to estimate Cd residues, carcass quality, and histopathological study. Results showed a significant alteration in hematological, biochemical and histopathology of Cd treated group which was improved by treatment with Spirulina which indicate the protective role of Spirulina against Cd toxicity.

Protective Actions of Vitamin E and Zinc on Nickel Induced Hematotoxicity and Hepatotoxicity in Swiss Albino Mice

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Abstract

The present investigation focused on examining the protective effects of vitamin E and Zinc against Nickel (Ni) toxicity on hematological parameters and the hepatic system in mice, considering the widespread issue of heavy metal toxicity and the concurrent generation of free radicals in biological systems, commonly associated with various agricultural practices. The study involved the random allocation of mice into five groups (n=10). Group A received a normal diet, Group B was exposed to Ni at a dosage of 20mg/kg body weight (bw) per day, Group C was subjected to Ni along with vitamin E (20mg/kg bw/day + 400mg/kg bw/day), Group D received Ni in combination with Zinc (20 mg/kg bw/day + 400 mg/kg bw/day), and Group E was treated with Ni, Vitamin E, and Zinc (20 mg/kg bw/day + 400 mg/kg bw/day + 400 mg/kg bw/day) for a duration of 12 weeks. After the 12-week treatment period, the mice were euthanized for a comprehensive analysis of the impact of vitamin E and Zinc on Ni-induced toxicity in terms of hematological parameters and liver function and structure. The findings revealed that Ni exposure led to a significant reduction in total erythrocyte count (TEC) *($p<0.01$),* hemoglobin concentration (Hb) *($p<0.01$),* packed cell volume (PCV) *($p<0.01$)* and mean corpuscular volume (MCV) *($p<0.01$).* Conversely, Ni significantly elevated the levels of liver enzymes such as AST *($p<0.05$),* ALT *($p<0.01$),* and ALP *($p<0.01$).* Histological examination of Ni-treated livers exhibited hepatocyte disarrangement and the presence of inflammatory cells around the central vein. However, supplementation with vitamin E and Zinc demonstrated a protective effect, restoring these hematological and hepatic parameters. In conclusion, the study suggests that Ni has adverse effects on hematology and the hepatic system, and these effects can be mitigated through the administration of vitamin E and Zinc.

Hypoglycemic, Lipid-lowering and Atheroprotective Effects of Aloe Vera Gel on Streptozotocin and High Fat Induced Type-2 Diabetes in Mice

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Abstract
The present study was conducted to investigate the effect of Aloe Vera on hematology, blood glucose, serum insulin and glucose tolerance, serum lipid profile and histopathological alterations in liver, and pancreas in diabetic Mice. A total of 90 Swiss Albino mice (Mus musculus), aged 25-28 days divided into 6 groups such as A-Control, Group B-diabetic control, Group C-diabetic control plus aloe vera treated group, Group D-high fat treated group, Group E-high fat diabetic group, Group F-high fat diabetic plus aloe vera treated group. At Day 60, Hematological parameters (Hb, TEC, PCV, TLC) in High fat and diabetes induced group were significantly reduced compared to control. On the other hand, the addition of aloe vera revealed a restoration of the values compared to obese and diabetic mice. At day 60, blood glucose level was increased in diabetic control compared to the healthy control, whereas it was decreased aloe vera group and opposite results in case of serum insulin level. In case of lipid profile serum TC, TD, LDL levels were increased in diabetic control and high-fat diabetic group compared to the healthy control; whereas it was decreased in the high-fat diabetic plus aloe vera group compared to both diabetic control and high-fat diabetic mice and opposite results for HDL level. Section of liver, and pancreas of the control group showed normal tissue structures. But Diabetic mice showed major changes in the hist-structure. In the case of aloe vera treated mice, there were no detectable changes.

Prenatal Exposure to Environmentally Relevant Perfluorooctanoic Acid on Reproduction and Immunotoxicity in F1 Offspring Mice

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Abstract
The study investigated the effects of prenatally exposed of PFOA on body weight, reproductive parameters and immune cells in F1 offspring mice. 30 male and female mice, aged 28-30 days were purchased from ICDDRB, Dhaka. Mice were assigned into three groups, namely A, B and C each consisting of six female and four male mice. Group A served as vehicle control and was given normal mice pellet, group B was administered perclorooctanoic Acid (PFOA) at the dose 30 mg/kg/day, group B received PFOA at the dose 60 mg/kg/day. Body weights were recorded at 15 days intervals. At the end of the experiment, blood and testis were collected and processed for semen evaluation, hormonal and histo-pathological study. The results demonstrated that the F1 offspring mice born from PFOA exposed mice exhibited a substantial reduction in body weight ($p<0.01$), which was dependent on both the dosage and duration of exposure. The male offspring mice treated with PFOA saw a notable ($p<0.01$) decline in testosterone levels and a rise in T4 levels. Additionally, there was a significant ($p<0.01$) decrease in sperm count and sperm motility, while the concentration of estradiol in the female offspring mice (F1) remained mostly unchanged. The testis size and weight of F1 male mice were diminished following exposure to PFOA. The number of offspring delivered by mice treated with PFOA was decreased. The histopathological examination of the testis revealed the presence of degenerative and necrotic alterations in the seminiferous tubules and sertoli cells, which displayed irregular morphology in mice treated with PFOA. Like the parental mice, the total leukocyte count (TLC) and differential leukocyte count were at a minimum, while the number of neutrophils was slightly higher in mice born from the PFOA treated group. However, there was no significant increase in the total white cell count. Therefore, it can be inferred that PFOA has harmful effects on the reproductive health of parental mice, which can be transmitted vertically and affect the offspring mice

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High Fat Diet Induced Metabolic Syndrome in Adult Male Mice

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Abstract
The study aims to evaluate the effects of a 10-week high -fat diet on various parameters in mice, including body weight, Hematological parameters, biochemical markers, and liver histology, focusing on changes in serum uric acid, glucose, lipid profile and liver function test as well as liver histopathology. Forty mice (two replication) were allocated into four groups: a control group (A) receiving a standard mice pellet, and three treatment groups (B, C, and D) with 10% dietary fat from mutton, beef, and soybean oil, respectively. Animal fat groups (B& C) display a notable increase in body weight with higher serum glucose level and glucose intolerance but soybean oil group (D), which demonstrated lower glucose levels. All treatment groups exhibited higher serum triglyceride, cholesterol and LDL levels but comparatively lower in soybean treated group. Serum uric acid was significantly lower in the beef and soybean oil groups. Liver function test such as ALT and AST values were significantly higher in group C and D. Liver histology indicated vacuolar infiltration, hepatic necrosis, and fatty droplets. The ingestion of a high fat diet led to developed obesity, hyperglycemia, glucose intolerance, dyslipidemia and impaired liver function. Liver histology also showed adverse effects on a high fat diet. These finding suggest a potential induction of metabolic syndrome like conditions by high fat diets. Advocating for avoiding or restricting such diets could prove beneficial for human health.

A Comparative Study on the Chemical Composition of Fish Between Wild and Cultured Fishes of the same Species

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Abstract
Fish as food plays an important role in our life. For nutritional aspect, five fish species like Rui (*Labeo rohita*), Catla (*Catla catla*), Shing (*Heteropneustes fossilis*), Golsha (*Mystus bleekeri*), and Pabda (*Ompok pabda*) usually available and consumed in Bangladesh were analysed for proximate composition. The samples were collected from Mymensingh and Sirajganj District of Bangladesh. The moisture, protein, fat and ash contents of the fishes were determined using loss in weight, micro-Kjedahl, dry-ashing and solvent extraction methods. The average moisture contents of the wild fishes varied from 71.75 to 75.17 (g/100g) with Rui having the highest moisture content followed by Pabda. The average moisture contents of the farm fishes varied from 75 to 80 (g/100g) with Catla having the highest moisture content followed by Pabda. The protein contents of the wild fishes ranged from 15.18 to 16.48 (g/100g) whereas the protein content of farm fishes varied from 15.8 to 17.1 (g/100g). The average lipid contents of the wild fishes varied from 2.24 to 4.17 (g/100g) with Pabda having the highest lipid content followed by Shing. Whereas, in farm fishes, Pabda (4.68) have the highest and Catla (1.36) has the lowest lipid content. The wild fish have higher ash, fiber and carbohydrate content than the farm fishes. Fish in the wild eat a natural diet whereas fortified feed is given in aquaculture to increase growth and production. These potential differences between aquaculture and wild fish production create a difference in the chemical composition. Thus for nutritional aspect analysis this study suggests wild fish as the source of fish consumption.

Detection and Quantification of Melamine in Milk, By-products and Dairy Products by High-Performance Liquid Chromatography (HPLC) and Observation of Toxic Effects of Melamine in Mice in a Dose-dependent Manner Detected in the Analyzed Samples

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Abstract
Milk is a naturally nutritious food for humans, especially children solely dependent on milk and can be supplied commercially. Non-protein nitrogenous substances can alter the percentage of protein content in commercial milk. Melamine, a nitrogenous substance, can be used as an adulterant in milk to show an increase in protein content. This study focused on detecting melamine levels in commercially available different types of milk, dairy products, and by-products to estimate the risk caused by it. The quantification was performed by The High-Performance Liquid Chromatography (HPLC). The presence of melamine was detected above TDI (Tolerable Daily Intake) among most of the categories. All eight brands of commercial powder baby milk contained melamine above TDI (1 ppm) that ranges 30-1142 times higher than the acceptable level. In adults brands, all eleven commercial milk samples (powder and liquid) showed the presence of melamine above TDI (0.2 ppm) that range from 42-5142 times higher than TDI. Among dairy products (ice-cream, yogurt, condensed milk and whey), melamine was detected at a varying degree of levels (1- 31 times above TDI) and in some cases melamine was not detected. In animal experiment in a dose dependent manner (250, 500, 1000, 1500 ppm) it was found that melamine toxicity increased Hb%, creatinine, TEC level that indicated renal toxicity and polyuria. The increased level of SGOT and SGPT indicated the liver damage. The weight and length of the testis and epididymis were higher in the 250 ppm and gradually reduced from the higher to the lower melamine-treated group. Sperm motility and concentration decreased with an increased dose of melamine. The percentage of abnormal sperm had significantly increased in the melamine-treated groups in a dose-dependent manner like neck torsion, deteched head, bent tail, and coiled tail etc. A careful approach is needed to handle such a sensitive national issue.

Evaluation of Hematoprotective, Hepatoprotective, and Anti-inflammatory Potentials of Chia Seed (*Salvia hispanica* L.) Extract in Rats

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Abstract
Due to high nutritional value with numerous health promoting properties, *Salvia hispanica* L. (chia) has been exploited as a super food. The present study was conducted to evaluate the effects of chia seed extract on CCl_4-induced hepatotoxicity, hematological profile, and carrageenan-induced inflammation in male Wistar rats. Ethanol-acetone extract of chia seeds at the doses of 200 and 400 mg/kg body weight/day were applied to evaluate the comparative protective roles. Hematological profile and serum biochemical parameters such as ALT, AST and creatinine were measured to evaluate the hematoprotective, and hepatoprotective effects of chia seed extract. Paw thickness and motility level were assessed at 0, 1, 3, 5, and 7^{th} hours after sub-planter injection of carrageenan to evaluate the anti-inflammatory potential. Tissue histopathology was performed in both cases. Chia seed extract reduced the elevated level of serum AST and ALT significantly in a dose-dependent manner following intra-peritoneal injection of CCl_4. Histopathological study of the liver tissue exhibited acute impairment of the hepatocytes and liver parenchyma following CCl_4 exposure, which was markedly regenerated by the chia seed extract treatment. Protective effects of the extracts in induced oxidative stress were also evidenced in the amelioration of the abnormalities of RBC count, Hb (%), PCV (%), ESR, and neutrophil count. Chia seed extract was found to inhibit the carrageenan-induced paw edema and motility level in a dose-oriented fashion. Histological examination of the paw tissue revealed severe inflammation characterized by massive infiltration of inflammatory cells and thickening of the dermis in the carrageenan group, which were significantly reduced by chia seed extract

treatment. The higher dose of chia seed extract showed significant increases in bodyweight gain and feed efficiency ratio but decrease in visceral fat deposition. These results suggest that chia oil possesses potentials for hematoprotective, hepatoprotective, and anti-inflammatory activities in the experimental animal.

Hepatoprotective, Anti-Inflammatory and Wound Healing Effects of S*pirulina Platensis* in Rats

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Abstract
Spirulina is considered as a functional food. This study assesses the hepatoprotective, anti-inflammatory, and wound healing effects of *Spirulina platensis* in rats. Carbon tetrachloride (CCl_4) and carrageenan were employed to trigger hepatotoxicity and inflammation respectively. The wound-healing capability was examined by making a 6 mm round wound with a biopsy punch. Animals received spirulina at the dose rate of 250 mg and 500 mg/kg body weight (bwt). Paw thickness was measured at 1, 3 and 6 hours following carrageenan injection. The serum ALT and AST were significantly increased by the intra-peritoneal injection of CCl_4 in rats. These biochemical parameters were significantly decreased by the treatment of spirulina. CCL_4 caused hepatic cellular necrosis, congestion of central vein and steatosis which were improved by spirulina treatment. It also decreased the volume of paw edema and shortened the closing time of wound in a dose-dependent manner. Histopathology of the paw tissue demonstrated severe infiltration of inflammatory cells and thickening of the epidermis which were remarkably improved by spirulina. The anti-inflammatory and wound healing properties were comparable with that of the indomethacin. Our results evidenced that spirulina has potent hepatoprotective, anti-inflammatory, and wound healing effects in rats.

Knowledge, Attitudes and Practices of Farmers Regarding Pesticides Usage and Analysis of Pesticides Residue in Vegetables, Fruits, Dry Fish and Tea Leaves

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Abstract
The study was conducted to know the knowledge, attitude and practices of vegetable farmers regarding pesticides use. Then we detect the level of pesticide residue (chlorpyrifos, cypermethrin, and abamectin) in vegetables, dry fish, tea leaves, and different fruit samples by qualitative (TLC) and quantitative (HPLC-UV) analysis. The vegetable samples were collected from fields and markets of four Upazila of Mymensingh district. Dry fish, tea leaves and fruit samples were from local markets. A standard questionnaire survey was conducted where most farmers (70%) denied using the pesticide in vegetable production. However, the positive results indicated their indiscriminate use. Only bean and bitter guard were detected positive for cypermethrin both in TLC and HPLC detection. Though chlorpyrifos and cypermethrin tested positive in TLC analysis but only cypermethrin became positive above MRL after HPLC detection. In the case of dry fish, only chepa dry fish was detected positive above MRL for abamectin in HPLC. Whereas, for tea leaves and fruits, pesticides were not detected in any sample both in TLC and HPLC detection. Nevertheless, an effective monitoring system for pesticide use in vegetable and dry fish production should be implemented as soon as possible for public health concerns and more samples of dry fish, fruits, and tea leaves need to be analyzed for different kinds of pesticide residues.

Development and Strengthening of De Novo Thin Layer Chromatography Analytical Technique to Analyze & Control Residues of Veterinary Antibiotic Drugs in Poultry Products and Byproducts: A Need Based Technology Development & Research Arena to Save Human Health

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Abstract
Antibiotic therapy has great importance in human and veterinary medicine. However, indiscriminate uses of antibiotics become a matter of concern for antimicrobial residues and resistance. To ensure consumer protection, this work is designed to develop proper mobile phases for precise detection and conclusion of antibiotics residues present in the poultry products and byproducts in Bangladesh. The TLC Silica gel 60F254 was used as stationary phase. We started the test with a common starting solvent 1:1 hexane: ethyl acetate followed by different ratios of varieties of chemicals and/or combinations of chemicals. We developed best mobile phases for specific antibiotics usually practiced in poultry production in Bangladesh. We established acetone: acetic acid: methanol (1:1:1) for amoxicillin; acetone: acetic acid (1:1) for cephalexin; methanol: acetonitrile: acetic acid (1:1:1) for oxytetracycline; methanol: toluene: acetic acid: acetone (2.5:2:2:2) for chlortetracycline; acetone: methanol (1:1) for ciprofloxacin; acetone: acetic acid: methanol (1:1:1) for enrofloxacin; methanol: acetonitrile: acetic acid (1:1:1) for levofloxacin respectively. After fixing the best mobile phases for each antibiotic, we validated the technique by testing our indoor and field poultry samples. We further investigated whether TLC analysis could be used for quantitative analysis of antibiotic residue in samples. Concentration dependent analysis of samples by TLC demonstrated quantification of antibiotics presence in the samples. Therefore, the TLC technique would bring success to the livestock sector to combat veterinary antibiotics residues and human health hazards.

Discriminate and Indiscriminate use of Ciprofloxacin Antibiotic in Poultry and Its Effects and Residual Status in Different Edible Tissues: A Health Perspective Study in Bangladesh

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Abstracts
Indiscriminate and non-judicious use of antibiotics has significant effects on human health causing antibiotic resistance. Antibiotics resistance is a worldwide problem including Bangladesh. Thus, this project was designed to detect the presence of Ciprofloxacin antibiotic residue in edible tissues and its effect on hematological and enzymatic parameters in broilers. In this study, we used broiler chicks to investigate the judicious use of ciprofloxacin for human consumption. On day 14, the chicks were randomly divided into three groups namely control, discriminate and indiscriminate antibiotic groups. The treatment was started from the day 14 onward. The discriminate group was treated with ciprofloxacin @ 100mg/Liter drinking water for 7 days followed by withdrawal period of 7 days. On the other hand, indiscriminate group birds were treated with ciprofloxacin @ 100mg/Liter drinking water for 14 days without maintaining any withdrawal period. Body weights of the birds were recorded daily. On day 14^{th}, body weight of all groups of birds were not statistically significant, however, the mean body weight at 28^{th} day was statistically significant in indiscriminate group (1601.43±15.50gm). Thin Layer Chromatography (TLC) analysis revealed ciprofloxacin residues in all the samples of indiscriminate group were positive but did not detect any antibiotic residue in control sample and in discriminate group 2 liver samples, 3 kidney samples, 1 spleen sample and 1 breast muscle sample were found positive but no residues found in thigh muscle samples. Effects on hematological parameter showed that the means of three different groups were statistically significant only in TEC, Hb & ESR but not in PCV. ALT & AST enzymatic analysis of blood serum showed no significant changes in both treated and control birds. The investigation is continuing and need more investigation for precise conclusion. Therefore, the judicious use of ciprofloxacin antibiotic is essential in poultry sector to ensure human health.

Dietary Effects of Chia Seed (*Salvia hispanica* L.) Extract in Improving Induced Hyperlipidemia and Steatohepatitis in Mice

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Abstract
Salvia hispanica L. (chia) seed is considered as one of the most distinguished nutritious foods having a wide range of medicinal properties. The present study was conducted to evaluate the dietary effects of chia seed extract in improving induced hyperlipidemia and steatohepatitis in Swiss albino mice. n-hexane extract of chia seeds at the doses of 200, 400, and 600 mg/kg body weight/day were applied to evaluate the comparative antidyslipidemic and antisteatotic activities in mice supplemented with 10% butter fat in feed. Serum biochemical parameters were determined, which was followed by histopathological study of the liver tissue. Chia seed extract reduced the elevated level of serum cholesterol, triglycerides, LDL, ALT, AST and increased the concentration of HDL significantly in a dose-dependent manner following supplementation with butter fat. Although chia seed extract at the doses of 400 and 600 mg/kg/day showed significant effects in improving the biochemical parameters ($p < 0.05$), 600 mg/kg/day was found to be the most effective in the amelioration of dyslipidemia. Histopathological study of the liver tissue exhibited severe centrilobular necrosis, massive degeneration of hepatocytes and steatosis, vacuolation and ballooning of hepatocyte, congestion of central vein, sinusoidal dilatation following butter fat consumption, which was markedly alleviated by the chia seed extract treatment. Hepatic regeneration is attributed to the potency of the extracts in hepatoprotection as in harmony with the biochemical parameters. The results suggest that chia oil possesses potentials for anti-hyperlipidemic and antisteatotic activities in the experimental animal in a dose-oriented fashion.

Screening of Haemoprotozoan Parasites in Indigenous and Crossbred Cattle of Bangladesh Using Molecular Biological Tools

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Abstract
Haemoprotozoan diseases, especially babesiosis, theileriosis and anaplasmosis are considered among the economically most important protozoan diseases. These tick-borne diseases (TBDs) are widely distributed throughout the world especially in tropical and subtropical countries. In cattle, babesiosis is caused mainly by *Babesia* (*B.*) *bovis* and *B. bigemina*, theileriosis is caused by the protozoan parasite *Theileria (T.) annulata* and anaplasmosis is caused by *Anaplasma* (*A.*) *marginale*. These diseases cause devastating losses to livestock industry throughout the world. There are limited studies in Bangladesh on the application of specific molecular diagnostics for detecting the blood protozoan diseases and genetic characterization of these species is also scarce. In view of providing detailed and accurate information on the detection of haemoprotozoan species, till now, a total of ~260 blood samples were collected in EDTA-vacutainer tubes from randomly selected indigenous and crossbred cattle from Mymensingh and Sirajgonj districts. Thin blood smears were prepared and examined under a binocular microscope (×100) to detect the haemoprotozoan species. Up to now, DNA was extracted from 80 cattle blood samples. PCR of the extracted DNA was performed for the detection of *B. bovis, T. annulata and A. marginale*. In microscopic examination, a total of 30 % of cattle blood were found to be infected with *A. marginale* and *A. central* till now. Only 2 samples were detected for *Theileria* species. Three samples were found to be positive with mixed infections *A. marginale, A. centrale and Theileria* sp. In PCR, Out of 80 samples, 10 samples (12.5%) were found to be positive with *A. marginale* in PCR. Additional blood samples will be analyzed for the amplification and detection of haemoprotozoan species. PCR products of the positive samples will be sequenced and phylogenetic analyses of the obtained data will be undertaken. The outcome of this proposed research project will enhance our knowledge about the molecular epidemiology of haemoprotozoan diseases and thus will be helpful to design the efficient monitoring and control strategies of TBDs in Bangladesh.

Screening of Anthelmintic Residues in Dairy Milk by Thin Layer Chromatographic Method and Their Public Health Risk

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Abstract
Anthelmintics, the drugs used against parasitic infections, such as benzimidazoles and probenzimidazoles, are veterinary drugs used against endoparasites in food producing animals. A number of these drugs are considered responsible for embryotoxicity and teratogenicity and other adverse effects in human through milk consumption. The milk samples and ice-cream were purchased from the local markets of the selected area for screening of drug residues. Pre- coated TLC plates (Silica Gel 60 F254, 20 × 20 cm) were purchased. A micropipette was used for the loading of the samples on the TLC plate. The plates were run by using a glass twin trough (10 × 10 cm) chromatographic development chamber. A UV-visible cabinet model was used for the visualization of the developed spots. The plates were marked up to the distance of 75 % from the sample loading site as a solvent front. The Milk samples (150) evaluated by thin layer chromatography revealed 40% residues of Trickla-bendazole and Levamisole combination and oxyclosanide anthelmintics whereas 68% ice cream revealed anthelmintic residues. The use of such drugs in farm animals is associated with the presence of their residues in tissues and milk, which may have an adverse effect on the health of consumers. The fight against parasitic infections in small ruminants is a challenge for both breeders and veterinarians. A growing concern lies in the increase in antibiotic resistance in the country. However, this preliminary study indicates an alarming condition for the public health risk especially for the pregnant women and growing children. The present study of anthelmintics residues address the need of monitoring to estimate the ongoing deworming program among farmers and farms and for the design of conservation and management programs of deworming nationwide.

Caenorhabditis Elegans as a Model for Biomedical Research for the First Time in Bangladesh

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Abstract
Anthelmintic resistance in nematode has become a global issue. *Caenorhabditis* elegans is a useful model system to study anthelmintics and offers throughput that is not possible with parasitic nematodes. Among the South Asian countries, there was no C. elegans Lab except India. In spite of having a huge resource of medicinal plants, this region is far behind in drug discovery research using C elegans compared to other continents. Following standard protocols, all the animals were cultured in NGM agar plates. During the culture, the physiology, reproductive biology, feeding behavior and growth rate of *C. elegans* were observed with much enthusiasm for subsequent maintenance and storage of the worms in -80C and liquid nitrogen in the Lab. The preliminary survivability tests were conducted to observe the motility of the different stages (L1 to adult) of *C. elegans* at 22C temperature using commonly used nematocidal drugs (Albendazole, Levamisole and Ivermectin) at different concentrations (.1, .01, .001, .0001, and .00001 µg/ml) and plant extracts from Neem and Moringa leaves at different concentrations (1%, 2.5% and 5%) in 96 well plates in controlled environment. The survivability test revealed that ivermectin and levamisole killed all the worms within 10 to 15 minutes in higher concentrations whereas more than 30% worms survived in albendazole treated group. Importantly, no worms survived in both the plant extract treated groups. Bangladesh has plentiful medicinal plants having anthelmintic potency. Therefore, active plant biomolecules from these plants need to be extracted to screen their potentiality in killing nematodes. Therefore, establishment of C. elegans will be useful for the discovery of new anthelmintic in this region. Isolation and characterization of active plant biomolecules to be tested on this model organism to foster drug discovery.

Prevalence and Diversity of Gastrointestinal Parasites Associated with Diarrhoea in Buffalo Calves under Extensive Buffalo Farming in Bangladesh

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Abstract

Buffalo calves are the future for livestock industry. Calf care is not only essential for sustenance of the dairy industry but essential for quality germ plasm in preserving and maintaining good trait. Buffalo calves are one of the most popular ruminants reared in extensive condition for basically milk and meat. Gastrointestinal (GI) parasitism in calves possesses a critical warning factor that severely disrupts the growth performance. Effects of GI parasites may vary with age, sex of calves, nutritional condition and severity of infection and rearing practices. Thus, the current study was aimed to assess the prevalence and diversity of GI parasites in buffalo calves in Bangladesh. The fresh fecal samples (n=75) of buffalo calves suffering from diarrhea were collected and immediately preserved in cool conditions. These samples were processed via direct wet mount, sedimentation and floatation methods and examined under a light microscope. The results showed an overall 100% prevalence of GI parasites in the buffalo calves with diarrhoea. Among these, *Toxocara*, *Cryptosporidium Eimeria*, *Balantidium coli*, *Fasciola* and amphistomes were the most prevalent parasites in calves suffering from diarrhoea. One calf died due to severe GI parasitic infection that revealed after post-mortem. The higher prevalence and greater diversity of GI parasites indicate the association with the calf rearing husbandry practices under extensive buffalo farming condition in Bangladesh. Sharing of the same pastureland and water bodies by buffaloes significantly increases the prevalence of GI infection via interspecific transmission. The existing practice of rearing calf and adult buffaloes and other livestock within the same shed pose the potential risk of diarrheal pathogen transmission. Therefore, training to the local buffalo farmers for healthy husbandry practices and therapeutic strategies for buffalo calves should be provided to reduce the cross-transmission of potential diarrheal parasites and calf mortality for profitable buffalo farming in Bangladesh.

Prevalence of Chicken Coccidiosis and Associated Risk Factors in Existing Farming System of Bangladesh

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Abstract

Introduction: Coccidiosis is a major problem in the farm with inadequate hygienic measures and factors such as age, breed, body conditions, and biosecurity which are the most common factors that contribute for the occurrence of coccidiosis. Methodology: A cross-sectional study was conducted on chicken coccidiosis of native and exotic breed rearing in different management systems in Bangladesh with the aim to determine the prevalence of coccidiosis and to assess the associated risk factors. A total of 1500 fecal samples from different breeds (native and exotic), age, and sex were collected from August 2021 to September 2023 in different districts of Bangladesh. Fecal examination using flotation and McMaster counting techniques were used for qualitative and quantitative studies, respectively. The study also involved a questionnaire survey for the assessment of possible risk factors. Findings: Among 1500 chickens examined for Eimeria oocysts 87 (5.8%) of the chickens were found positive for coccidiosis. Infection was higher in exotic breed (7.96%) compared to native chicken (4.13%). The study reported 18.40% 13.98%, 12.09%, and 3.40% prevalence in Assel, Broiler, Sonali, and Deshi chicken breeds, respectively. No infection was found in Neked Neck, Hilly and Fayoumi breeds. The result showed 9.80% of male and 4.98% female chickens found

infected with Eimeria. Chicken fed with Commercial feed (7.88%) showed significantly ($p < 0.0013$) higher prevalence of coccidiosis compared to Local feed (3.99%). Infection was found more in chicken reared in Intensive system (15.27%) compared to Free ranging system, but no infection was found in chicken reared in Intensive without using litter, Semi-intensive with litter and Semi-intensive without litter systems. Conclusion: Changing the rearing systems and challenge infection are needed to confirm the resistance or tolerance of the breeds those showed low or no infection with Eimeria species.

Molecular Detection of *Neospora caninum* from Aborted Fetuses of Cattle, Sheep and Goats in Bangladesh

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Abstract

Neospora caninum, an apicomplexan protozoa causing reproductive and economic losses in the livestock industry worldwide. In Bangladesh, abortion is a major problem in livestock production. The aim of the study was to detect of *N. caninum* by nested PCR (nPCR) in aborted fetuses of cattle, sheep, and goats in Bangladesh. The head portion of each aborted fetus (111) was dissected at each sampling site and transferred to the laboratory in ice box. Data on risk factors associated with *N. caninum* infection were simultaneously collected. DNA was extracted from brain tissue to perform nPCR targeting ITS1 rDNA gene of *N. caninum* and sequencing was performed from the representative positive samples. By nPCR, *N. caninum* was found in 16.0% aborted fetus of cattle followed by sheep (14.81%) and goats (11.78%). Highest prevalence was found in aborted fetus of animals during second trimester (27.78%) of pregnancy with aged 2 to 4 years (18.75%). Obtained sequences showed 99% to 100% similarity with *N. caninum* ITS1 rDNA gene deposited in GenBank. Univariate analysis demonstrated that pregnancy stages (trimesters), abortion history of the animals, and access of dog in animals farm were significantly ($p \leq 0.05$) correlated with *N. caninum* infection. This study represents the first investigation into the molecular detection, phylogenetic characterization, and analysis of risk factors associated with *Neospora caninum* in livestock in Bangladesh. The research findings suggest that *N. caninum* infection could be a contributing factor to instances of abortion and resultant economic losses in the country's livestock production.

Investigation of SARS-CoV-2 Infection in Domesticated Animals from COVID-19 Affected Households in Bangladesh

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Abstract

The emergence and rapid global spread of the novel coronavirus disease (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has sparked significant interest in understanding its zoonotic origins. This study aims to investigate animal and environmental samples in Bangladesh to identify the zoonotic source and reverse zoonosis of SARS-CoV-2. This research adopted a comprehensive approach to gather and analyze samples from various animal species, including cattle, sheep, goats, cats and dogs that are peridomestic in nature or remain in close contact, ensuring biosafety and avoiding cross-contamination. SARS-CoV-2 or related coronaviruses were identified using immunological detection and real-time reverse transcription-polymerase chain reaction (RT-qPCR). A total of 1028 samples from different regions of Bangladesh were collected from cattle (552), sheep (135), goats (112), cats (118), and dogs (111) of which 465 were rectal, 363 nasal swabs, and 200 blood samples. The samples were collected from those areas where there were human records of COVID-19 during July 2021- December 2022. The blood samples were collected and immediately used for antibody screening. No positive samples were found in both antibody test screens and RT-qPCR in fecal and nasal swab samples. The study indicated that no COVID-19 infection was found in domestic animals and pets, despite staying in close contact with COVID-19 patients or households. The study suggesting a limited risk of transmission from these animals to humans within the studied context. It's possible that domestic animals are not significantly involved in the COVID-19 epidemic.

Molecular Characterization and Detection of Snail Vector Host of *Tracheophilus cymbius,* the Tracheal Fluke of Ducks

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Abstract
The snail-borne tracheal flukes of ducks cause respiratory distress, deceased production and even may lead to death of ducks leading to colossal economic losses to the farmers. So far, the tracheal flukes are identified by their characteristic morphological features only. Also, its vector snail hosts are not yet known in Bangladesh. This pioneering research work was conducted for molecular identification and snail vector host detection of the tracheal flukes in ducks in Tarakanda upazila, Mymensingh from July, 2022 to June, 2023. For this study, a total of 100 ducks were slaughtered and thorough post-mortem examination showed that 16 (16%) ducks were infected with the tracheal fluke, *Tracheophilus cymbius. T. cymbius* was recovered either from the trachea (87.5%, 14/16) or from nasal passage (37.5%, 6/16) of the infected ducks. The flukes were found both in trachea and nasal passage in 4 (25%, 4/16) ducks. The load of *T. cymbius* ranged from 1- 10 in the infected ducks. The adult parasites measured 6.3-11.5 mm long and 3-4 mm broad. PCR amplification of the *cox1* and *nad* gene confirmed the *T. cymbius* species. *T. cymbius* were found to lay eggs in batch and unlike other trematodes, the eggs hatched into redia containing miracidia within 7-12 minutes. To detect the snail vectors, the laboratory reared naïve *Lymnaea auricularia*, *Lymnaea luteola*, *Indoplanorbis exustus*, *Viviparus bengalensis*, *Thiara tuberculata* and *Brotia* sp. snails were experimentally infected with the redia containing miracidia of the *T. cymbius*. The *T. cymbius* cercariae were detected in *I. exustus* snails 15-17 days following infection indicating that *I. exustus* is the potent vector/intermediate host snail of *T. cymbius* in Bangladesh. Identification of the antigenic genes of *T. cymbius* and countrywide investigation of vector snails are needed to develop effective control strategies against tracheal flukes in ducks.

Molecular Characterization of Paramphistomes and Biology of the Vector Snails

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Abstract
The paramphistomes (Trematoda: Paramphistomatidae) are the snail-borne trematodes which affect ruminants globally. In Bangladesh the prevalence of amphistomiasis ranges 60-100% in ruminants and causes emaciation, decreased production and also death. This study was conducted from July 2021 to June, 2023 to determine the genetic diversity of the paramphistomes in ruminants and also to investigate the biology of the vector lymnaeid snails. Five species of amphistomes, namely *Paramphistomum cervi, Homalogaster paloniae, Gartrothylux crumenifer, Gigantocotyle explanatum* and *Cotylophoron cotylophorum* were identified from cattle, buffaloes, goats and sheep. The species identification of the paramphistomes from different animals was confirmed by molecular technique using primers sets specific for ITS1, ITS2 and 18srRNA genes. The vector lymnaeid snails were identified as *Lymnaea auriculruia* by morphology and PCR amplification of the 18S rDNA gene fragment. Laboratory culture revealed that *L. auricularia* eats all types of food but shows prefers cucumber (*Cucumis sativus*) and lettuce (*Lactuca sativa*) leaves to boiled mango (*Magnifera indica*) leaves, khudipana/minute duck weed (*Lemna perpusilla*), and spinach (*Spinacia oleracea*) leaves. *L. auricularia* were found to lay eggs in sausage shaped capsule/batches on the supplied mango leaves, sticks and on the wall of the vats. The average number of eggs was 46 (4 – 223) per batch/capsule. The length of the egg capsules ranged from 0.3- 8.7cm and width from 0.2-0.6 cm. The egg hatching time was as short as 6 days in July and as long as 22 days in January. The maturation time (egg-egg) was also shorter in July (25-27 days) and longer in January (36-40 days). There were negative correlations with the environmental temperature and humidity with snail maturity and egg hatching time. *L. auricularia* can complete several generations in a year. Extensive study on biology and genetic characterization of the paramphistomes and *L. auricularia* is necessary to control te paramphistomes.

Molecular Detection of Dengue Virus in Natural Populations of *Aedes* Mosquitoes in Mymensingh City

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Abstract
Dengue is now a serious threat in Bangladesh, the outbreak occurring with increasing frequency from the year 2000 with a peak in last year (2023). An active surveillance of dengue virus in mosquito vectors can play a vital role to determine the true status of the disease in this area. This study was designed to identify the breeding places of mosquito, to identify adult *Aedes* species and to detect dengue virus through RT-PCR in field-collected *Aedes aegypti* and *Ae. albopictus* females in Mymensingh city. Larvae and pupae were collected from different breeding sites (artificial containers, flower tubs, tree holes, car tires, coconut husks, bamboo stumps, stagnant pools and city parks) and adult mosquitoes were collected using aspirators and human bait, and identified by microscopy. Adult *Aedes* females were pooled by species and area of collection, then stored at −70°C before processing for presence of DENV by RT-PCR. Total RNA was extracted from the filtrates using RNA extraction kit following manufacturer recommendations. cDNA was synthesized in vitro by reverse transcriptases. Already published primers was used to amplify dengue virus. Seventeen different varieties of wet containers were identified in Mymensingh city 13 types were positive. Disposable containers contributed the major portion (58.9%) followed by controllable (39.8%) and uncontrollable breeding containers (1.7%). Among the breeding containers in Mymensingh, coconut shells (28.6%) was the most available breeding place followed by flower tubs (22.2%), discarded tires (16.4%), earthen curd pot (7.7%), broken buckets (3.4%), planter tray (3.2%), discarded plastic pots (3.1%), plastic water bottle (2.7%) and discarded shoes (2%). Four types of mosquito larvae were identified from containers, e.g. *Ae. aegypti, Ae. albopictus, Armegeres subalbatus and Culex quinquifasciatus.* In Mymensingh city, *Ae. aegypti* was the most prevalent (40.6%) species among container breeders. A total of 5336 mosquitoes were collected from Mymensingh, among them, *Culex* was the most prevalent mosquito (83.3%), followed by *Anopheles* (12.5%) and *Aedes* (5.2%). *Ae. aegypti* was the major species (67.4%) than *Ae. albopictus* (32.6%) among the *Aedes* species. In this study, dengue virus detected by RT-PCR from *Ae. aegypti* only indicating that *Ae. aegypti* acts as the major vectors of dengue virus in Mymensingh city. From this result, community awareness about dengue and its vector will be increased and this study will facilitate the fruitful mosquito control as well as dengue control strategies.

Genetic Characterization of Blood Feeding Haemonchus Contortus Populations Isolated from Sheep and Goats Based on β-tubulin Gene Analysis

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Abstract
Anthelmintic resistance against gastro-intestinal nematodes especially *H. contortus* of sheep and goat is a global issue. To address the gravity and extension of AR in Bangladesh, genotyping of 160 adult *H. contortus* parasites were performed to confirm benzimidazole resistance allele from different geographic zones of Bangladesh based on allele specific PCR (AS-PCR). The genotype frequencies were 9.4% for homozygous resistant (rr), 61.2% for heterozygous (rS) and 29.4% for homozygous susceptible (SS) among the selected areas. The allelic frequency of the mutation conferring resistance (r) ranged from 27.5% to 52.5% indicating substantial existence of benzimidazole resistance in *H. contortus* in small ruminant nematodes. Therefore, it can be concluded that genotyping the F200Y polymorphism can be used to monitor the resistance and thereby to enhance the control on the development of anthelmintic resistance against *H. contortus* in small ruminant nematodes.the control on the development of AR against *H. contortus* in small ruminant nematodes.

Revealing Anticoccidial Drug Resistance and Genetic Analysis of *Eimeria tenella* Causing Caecal Coccidiosis in Chickens in Bangladesh

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Abstract
Chicken coccidiosis, an intestinal parasitic disease, results in great economic losses to the poultry industry worldwide including Bangladesh. Among the *Eimeria* species in chickens, *Eimeria tenella* is the most pathogenic one causing caecal coccidiosis and considered as the major threats for commercial poultry farms in Bangladesh. Despite the huge impact of caecal coccidiosis, there seems to be paucity of reports on genetic diversity and population structure of this parasite in Bangladesh. Hence, the main aim of the project was to explore the genetic diversity and population structures of *E. tenella* parasite in Bangladesh. Coccidia infected caeca was collected from poultry farms located in Mymensingh and Gazipur district, Bangladesh. Intestinal mucosal scraps was processed for oocyst isolation–identification using parasitological techniques followed by genomic DNA extraction from sporulated oocysts. For molecular analysis, the internal transcribed spacer 1 gene of *E. tenella* was amplified using species-specific primers and sequenced. After editing and alignment, 263 bp sequences were used for analysis. Genetic analysis showed seven distinct genotypes and detected six single nucleotide polymorphisms among the 18 *E. tenella* isolates. The nucleotide and genotype diversity were 0.00507 and 0.8235, respectively. A phylogenetic tree was constructed with 66 sequences (seven studied genotypes and 59 reference sequences from GenBank database). The neighbour-joining tree represented that the studied *E. tenella* isolates were grouped with reference *E. tenella* isolates with strong nodal support (100%) and the nucleotide sequences of *E. tenella*, *E. necatrix*, *E. acervulina*, *E. brunetti*, *E. maxima*, *E. mitis* and *E. praecox* formed separate clusters without any geographical boundaries. These findings will provide baseline data on the species conformation and genetic variations of *E. tenella*.

Detection of Genetic Variation and Benzimidazole Resistance-associated SNPs in the Isotype-1 β-tubulin Gene Predominate in *Haemonchus contortus*

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Abstract
Haemonchus contortus is one of the most important parasitic nematodes of small ruminants around the world, particularly in tropical and subtropical regions. The control of *H. contortus* and related gastrointestinal nematode has relied on the treatment with anthelmintic drugs including benzimidazoles (BZs). As benzimidazole (BZ) anthelmintics have been broadly used in Bangladesh, we hypothesized that resistance is widespread. Given the link between three known single nucleotide polymorphisms (SNPs, designated F167Y, E198A and F200Y) in the isotype-1 b-tubulin gene and BZ resistance, our goal here was to explore the presence of these mutations in *H. contortus* from small ruminants (sheep and goats) from different regions in Bangladesh using PCR-coupled sequencing. For all 20 individual male adults from seven *H. contortus* populations, SNPs F200Y (TTC to TAC) was detected. In total, three genotypes were detected among the seven populations of *H. contortus*. The primary genotypes (Hs-198 and Hs-200) homozygous at both P198 and P200 had frequencies of 33.3-100% in all seven *H. contortus* populations (Mymensingh, Madhupur, Rajshahi, Rangpur, Jhenaidah, Rangamati and Bhola. Interestingly, resistance and heterozygous genotype of at P200 was found only in *H. contortus* population of Bhola. Resistance was not detected in E198A (GAA to GCA) and F167Y (TTC to TAC). But interestingly .in chromatogram, it was observed that GAA changed to AAA at P198 which might be due to BZ resistance. In the seven *H. contortus* populations, the frequency of SNP E198 (susceptible) ranged from 0% to 100%. The frequencies of (resistant) SNP 200Y ranged from 0 to 50%, and from 0 to 50% for (susceptible) SNP F200.The findings of this first study of SNPs in the isotype-1 tubulin gene of *H. contortus* populations suggest that BZ resistance is prevalent in some regions of Bangladesh, and that any control strategy might focus on monitoring BZ resistance in this country.

Prevalence and Risk Factors for Pigeon Trichomoniasis in Mymensingh District of Bangladesh

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Abstract

Trichomoniasis, also known as canker, is one of the common infectious diseases of pigeons and squab caused by *Trichomonas gallinae.* Fundamental knowledge on the epidemiology are prerequisite to establish more consistent development of control for pigeon trichomoniasis. Therefore, the present research work was undertaken to identify prevalence rate and risk factors for the occurrence of pigeon trichomoniasis. A total of 90 pigeons and squabs were examined and data on age, sex, seasons were recorded and presence of *Trichomonas gallinae* was checked through microscopy of swab from oropharynx. Visceral examination through post-mortem was performed to examine concurrent helminth infection. Bacterial coinfection in oropharynx was detected through culture of oral swab in different media. Proportionate analysis was performed using Microsoft excel. From our study, until now 46.67% prevalence of pigeon trichomoniasis was recorded. A number of 48.64% female and 45.28% of males were found infected with *T. gallinae*. In age category, birds aged 0 to 3 months, >3 to 6 months and >6 to 9 months had 29.41%, 54.76% and 45.16% of infection rate, respectively. Seasonal prevalence was recorded as 50%, 45.45% and 52.94% for summer (March to June), rainy (July to October) and winter (November to February), respectively. Helminth infection was found in 66.67% of *T. gallinae* infected pigeon while all samples were found positive for one or more genus of Bacteria. In conclusion, this work indicated that high prevalence of pigeon trichomoniasis in Bangladesh and concurrent infections are common.

Fish-borne Zoonotic Parasites: A Meta-analysis on Bangladesh Perspective for Control

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Abstract

Fish-borne zoonotic parasites (FZPs) affect the human and animal health around the world, including Bangladesh. With the world's growing population and potential global trade of aquaculture and fish, the risk of development of fish and aquatic-derived zoonoses in humans are increasing. The main objectives of this study are to show the temporal-spatial trend regarding the zoonotic parasitoses and to draw a meaningful conclusion. This study summarized the info on the fish-borne parasite population diversity, their nationwide distribution, host preference and their impacts from vetero-medical perspectives. Meta-analysis of the existing data on FZPs in Bangladesh revealed that *Clonorchis, Opisthorchis, Metorchis, Metagonimus, Echinostoma, Echinoparyphium, Hypoderaeum conoideum, Paragonimus, Diphyllobothrium latum and Spirometra mansoni, Anisakis typica, Gnathostoma spinigerum, Capillaria* sp., and *Cryptosporidium* are affecting a versatile group of hosts including duck, dog, cat, human, chicken, African civet, peacock, lion, tiger, turkey etc. It was also found that the trend of publication or reports on FZPs is increasing since 2000 and highest in 2022. Mymensingh and Netrokona district were more explored compared to other parts of Bangladesh in relation to FZPs. Finally, this study provides the spatio-temporal distribution trend regarding the fish-transmitted zoonotic parasites and suggests significant concern for fish-consumers.

Development of an Ex Vivo Culture Method and Optimization of Chemotherapy against Ascaridia Galli, a Devastating Nematode Affecting Chickens

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Abstract
Ascaridia galli is the most common nematode in chickens. *A. galli* is highly prevalent in chickens reared in scavenging or semi-scavenging systems. Here, we studied *ex vivo* culture protocol and anthelmintic sensitivity of *A. galli* prevalent in Bangladesh. Through morphological study and molecular analyses, the isolated worms were confirmed as *A. galli*. Of the chickens examined, 45.6% (178 out of 390) were found infected. Age and sex of the chickens, and season of the year had the significant ($p<0.05$) impact on the prevalence of the infection. In heavy infections, *A. galli* blocked the small intestine. We developed a hen egg white-based long-term *ex vivo* culture protocol which supported the survival and reproduction of *A. galli* for more than a week. Levamisole (LEV) and ivermectin (IVM) efficiently killed *A. galli.* However, albendazole (ABZ), mebendazole (MBZ) and piperazine (PPZ) did not kill the worms even at higher concentrations. Taken together, our results suggest that *A. galli* is highly prevalent in semi-scavenging chickens in Bangladesh. *Ascaridia galli* can be easily maintained *ex vivo* in egg white supplemented M199 medium. LEV and IVM, but not ABZ, MBZ and PPZ, can be used for treating and controlling *A. galli* infections in chickens.

Analyses of Innate and Adaptive Immune Responses in Cattle against Fascioliasis

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Abstract
Fascioliasis is a food borne zoonotic disease caused by *Fasciola gigantica* and *F. hepatica*, popularly known as liver flukes. Here, we present immune responses and pathological lesions caused by fascioliosis in liver in cattle. Both chronic and acute cases were detected, however, chronic fascioliosis were more prevalent. The severely affected livers were characterized by the presence of heavy calcification of the bile ducts. Lumen of the bile ducts became dark and showed heavy deposition of dark or dark brown salts. Bile ducts became thick, prominent and lumen of the duct was almost obliterated. Parasites crawled out from the cut surface. Acute fascioliasis was characterized by hepatomegaly, tensed capsule, hemorrhagic tract, rounded edges of the livers, and immature flukes aggressed from the cut surface. We did histopathological analysis using H&E, Masson's trichrome (MT) and Congo Red (CR). MT stain confirmed the massive fibrosis and CR revealed infiltration of eosinophils. In addition, CR stain also detected deposition of excessive amyloid proteins. Furthermore, by sqRT-PCR, we found that expression of mRNA of IL4, IL6, IL13, but not IFN-γ was significantly upregulated in heavily infected livers compared to mild cases. To reinforce our data, we measure cytokines liver lysate by ELISA. So far, we estimated concentration of IL4 and IL6, which were highly expressed in heavily infected liver than moderately affected livers. Collectively, our results suggest that Th2, but not Th1, biased immune responses govern the immune-pathological consequences in the liver during fascioliosis in cattle.

Infective Stage of Human Liver Flukes, a Bio-carcinogen, in Common Estuarine Fises in Bangladesh

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Abstract
Metacercariae (MC), the infective stage, of fish-borne zoonotic trematodes have been reported from fishes in Bangladesh. Here, we collected and examined loitta (*Harpadon nehereus)*, hilsa (*Tenualosa ilisha*), rupchanda (*Pampus chinensis*) and vetki/koral (*Lates calcarifer*) fishes from different markets of Mymensigh. During examination, we recovered MC of fish-borne trematodes and on the basis of morphologic and morphometrical analysis, they were tentatively identified as the MC of *Metorchis*. So far, we recovered MC of *Metorchi* from koral and hilsa. To validate tentative identifications, we extracted total genomic DNA from the harvested MC. PCR was performed by employing specific primers and PCR products were electrophoresed. By PCR, presence of MC of *Metorchis* was confirmed.

Detection of Foodborne Parasites in Street Vended Foods and Associated Risk Factors in Mymensingh City: An Insidious Threat to Food Safety and Public Health

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Abstract
One of the major sources of gastro-intestinal illnesses in Bangladesh is street vended food which often associated with unhygienic practices of food preparation, food serving, source of food ingredients, water and the knowledge of food handlers. This study was designed to detect the prevalence of parasitic contamination in street foods in Mymensingh city and to identify the associated risk factors. A total of 180 samples of (4 markets X 3 replicates X 15 types) snacks, fruit juice and sliced fruits were examined, of which 68.3% (123/180) were contaminated with at least one or more different species of parasites. Thirteen (13) types of parasites were identified from snacks, fruit juice and sliced fruits in this study. Among the identified parasites, 5 types were protozoan parasites, namely *Entamoeba histolytica* (trophozoite and cyst), *Giardia lamblia* (trophozoite and cyst), *Eimeria sp* (oocyst) and *Balantidium coli* (cyst) and *Blastocystis* (cysts), and 8 types of were helminths, namely *Ascaris sp, Strongyloides stercoralis*, *Taenia sp*, *Enterobius vermicularis*, strongyles, *Schistosoma indicum*, *Fasciolopsis buski* and *Spirometra sp*. Among the parasites, protozoa were more prevalent (72%) than helminth infection (28%) in street vended foods. Among the snacks, fuschka was the most contaminated (5 types of parasites); in case of juices, sugarcane juice was contaminated with 5 types of parasites, and out of five sliced fruits, sliced pineapple was the most contaminated. Most of the vendors (51.7%) were belonging to the middle age group (31-50yr) and most of them (53.3%) have no formal education to read and write. Among 120 vendors, only 14 (11.7%) were taking anthelmintic. Considering marital status, most (85%) of the vendors were married and about 45 % of the vendors earn 10,000-20,000 taka per month. Most of the vendors (63.3%) use tap water for preparing foods, washing utensils and hands. Most of the vendors wash their hands (64.2%) and utensils (75%) often. About 76.7% of vendors do not cover their foods. Contamination of foods from street vendors with pathogenic parasites would increase the risk of disease to the population that consumes or works with these products.

The Immune and Cellular Response in Black Bengal Goat against the Establishment of *Haemonchus contortus* Infection

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Abstract
Haemonchus contortus is a highly pathogenic, blood-feeding nematode cause high morbidity of Black Bengal Goats (BBGs) in Bangladesh. Many genetic linkage studies revealed that BBGs is genetically superior to other caprine breeds. The study aimed to explore the resistance and susceptibility status of *Haemonchus* larvae in *vivo* in goats. Newborn goat kids were allowed to graze in the naturally infected pasture for 30 days. Additionally, they were also feed 2000 Hc L_3 every week for 4 weeks to ensure infection. After 4 weeks, levamisole (8 mg/kg) treatment was given to each kids. Each kids were rested for 3 weeks and that time FEC were determined every weeks by Modified McMaster technique. After 3 weeks, when FEC were decreased to 50 EPG then experimental infection was given. All kids were given orally dose of 10,000 L_3 and slaughtered at 0 dpi, 3dpi, 7dpi and 14 dpi. Before slaughter blood was collected from each kids for PCV and WBC determination. After slaughter, abomasum were collected. Abomasal content were removed in a separate petridish for larvae and adult worm. Abomasai and lymph node found at 0 dpi, 3dpi, 7dpi and 14 dpi were sectioned and stained by H&E for histopathology. At the same time fundic region of abomasai were also sectioned and stained by H&E for histopathology Hematology showed a significant increase ($P < 0.05$) in circulating WBC count among all treated groups. Histopathology revealed marked infiltration of PBMC in mucosa and submucosal layer of lymphnodes at 5dpi and 7dpi. Expression of IL4 and IL5 was upregulated on days 3, 5 and 7. BBGs unveiled similar type of histopathology and cytokine expression at all dpi. These results indicate that BBGs is much resistant against *H. contortus.* Further investigation is imperative on the cytokines expression associated with gut resistance against *H. contortus* in BBGs.

Seroprevalence of *Anaplasma* Infection and Molecular Detection of Tick-borne Blood Protozoa in Cattle from Selected Regions of Bangladesh

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Abstract
Tick-borne blood protozoan parasitic diseases pose constraints for livestock and dairy industry. The study was aimed to determine molecular prevalence of major tick- borne blood protozoan parasites with seroprevalence of *Anaplasma* infection in cattle. A total of 384 blood samples were randomly collected from different commercial cattle farms as well as farms of PG groups of LDDP project of the selected regions. To determine seroplrevalence of *Anaplasma* infection by cELISA were performed. DNA extraction of the samples and initially multiplex PCR was done for the presence of the infections and subsequently PCR was performed by specific genes of the parasites. A total of 311 DNA samples were amplified with their specific primers for *Anaplasma* 16SrRNA, *Theileria* 18SrRNA and *Babesia* 18SrRNA genes respectively. The positive amplicons from mPCR and PCR were further confirmed by amplification of their species specific primers like groEL, 16SrRNA, MSP2 (for *Anaplasma*) and MPSP, Tams1 (for *Theileria*) and were sequenced. The sequences were reanalysed through BLAST in the NCBI database and confirmed their similarities and phylogenetic tree was constructed. Seroprevalence of anaplasmosis was 42.3. The results revealed the molecular prevalence of *Anaplasma, Theileria,* and *Babesia* species 34.72%, 56.59% and 9.32% respectively. Coinfections of two or three parasites were 22.04%. The phylogenetic tree of the resulted sequence indicated the sequence similarity with the *16S rRNA* gene of *A. marginale* and *A. centrale* and *groEL* gene of *A. bovis* and Candidatus *Anaplasma cinensis,* respectively. *T. orientalis* (MPSP) sequences were separated into two clades, corresponding to Types 5 and 7. This is the first seroprevalence study of bovine anaplasmosis in Bangladesh. From this study the highest molecular prevalence (56.59%) of *T. orientalis* indicate an emerging bovine theileriosis in Bangladesh.

Analysis of the Antibacterial and Antiviral Efficacy of Ash Filtrates

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Abstract
Sanitizer plays an important role in reducing the risk of infection in humans and animals which are aqueous or alcohol-based chemical agents mostly. Due to inconsistent uses, microorganisms often becomeresistant to common sanitizers, particularly in animal farms. Organic antimicrobials can be an alternative. We prepared an organic sanitizer from household ashes and tested its efficacy against Salmonella sp. and Newcastle disease viruses. Household ashes derived from different sources were collected and obtained filtrates in water by layering charcoal, stone, sand, cotton, or gauze in a handmade filtration system. Salmonella from table eggs was isolated and incubated 10 µl (2.58*108 CFU/ml) culture either with different dilutions of ash filtrate or with 100% washing soda or with distilled water only. Afterwards inoculated in BG agar plates. The number of colonies was counted and statistically compared. 100µl Newcastle disease virus viruses (2.5 $X10^6$ EID50) on Petri dishes were sprayed with 250µl of different dilutions of ash filtrate and incubated for 30 minutes at room temperature. Swabs from the respective treated petri dishes were inoculated in 1 ml MEM. For each dilution of ash filtrate, 200µl was inoculated into embryonated eggs. After 4 days of infection, allantoic fluid (AF) was harvested and the hemagglutination test was performed and the titer was calculated. Using our handmade filtration system, we obtained a clear ash filtrate with a pH ranging from 8.5 to 10.5. Ash filtrates showed pH-dependent antibacterial activity against a pure culture of Salmonella sp. Spraying ash filtrate on infected eggs or dipping infected eggs in ash filtrates reduced bacterial loads significantly. Ash filtrates showed pH-dependent antiviral activity against Newcastle disease viruses in embryonated chicken eggs. Since ash filtrates showed antimicrobial efficacy, can be used as organic sanitizers to reduce infection risk in man and animals and could reduce antimicrobial resistance.

Highly Pathogenic Avian Influenza Virus Subtype H5N1 in Scavenging Ducks in Mymensingh Division

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Abstract
Scavenging domestic ducks are the natural reservoir of avian influenza viruses, which allow for the reemergence of new influenza subtypes and contribute to the transmission of highly pathogenic avian influenza (HPAI) H5N1 viruses. It is essential to understand the molecular epidemiology of HPAI H5N1 viruses in unvaccinated scavenger ducks to comprehend the possible evolution and spread of the virus. From June 2022–December 2023, 34 farms with scavenging ducks were monitored in the Mymensingh division. Most duck flocks ranged from 07 to 2500 with clinical signs, for instance, white eyes, torticollis, paralysis, greenish droppings, fever, coughing, ocular discharge, indigestion, incoordination, bending of the neck, convulsion, drowsiness, and so on. Out of 34 flocks, the subtype H5N1 was detected in 29.4% of duck flocks (N =10). Phylogeny and gene constellation analyses based on complete genome sequences of 3 HPAI viruses revealed the continuing circulation of H5 clade 2.3.2.1a genotype G2 in ducks sampled in 2022. In the HA protein of the study isolates, functionally meaningful mutations caused the loss of an N-linked glycosylation site (T156A), a modified antigenic site A (S141P), and a mutation in the receptor binding pocket (E193R/K). Consequently, the antigenic analysis revealed a significant loss of cross-reactivity of duck strains with contemporary viruses from other host species and periods. These results highlight the need for intensified genomic surveillance of HPAI circulating in scavenging ducks in Bangladesh.

Serological Response to Lumpy Skin Disease (LSD) in Recovered and Clinically Healthy Vaccinated and Unvaccinated Cattle from Selected Areas of Bangladesh

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Abstract
Lumpy skin disease (LSD) is one of the most economically important transboundary animal diseases that emerged in Bangladesh in 2019. The disease has a significant economic impact on household cattle owners in rural settings in Bangladesh. This study employs a multistage sampling frame to examine the seroprevalence of LSD in Bangladesh. A total of 1161 blood samples were collected from 105 households and four herds comprising 904 and 257 cattle, respectively. A cross-sectional study was undertaken in selected areas of the Mymensingh districts of Bangladesh between July 2021 and May 2023. A multistage sampling method was used, considering study areas, households and herd size, disease state, and vaccination status. The presence of LSD virus (LSDV) antibodies in serum was detected by using an enzyme-linked immunosorbent assay. The overall seroprevalence of LSD in the study area during the sampling period (July 2021 to May 2023) was 26.2 % (n = 304/1161; 95% confidence interval: 4.90–10.20). Based on the disease status, the seroprevalence of the recovered animal was 40.07%, significantly higher than that of the clinically healthy (animals that have never shown any clinical signs and were not vaccinated) but in contact with affected cattle (23.27%) and the ongoing infected (animals that were showing clinical signs when samples were collected) cattle (18.0%). Nonetheless, seroconversion in the vaccinated population lasts 6–12 months after vaccination, and animals that recover naturally also exhibited significant seroconversion up to 6 months after exposure. The study highlighted the seroprevalence of LSD in cattle from rural households in Bangladesh and revealed the short-term antibody responses in LSD-recovered, clinically healthy, and vaccinated animals. Therefore, the robustness of post-vaccination immunity or prior infection should be considered in defining vaccination strategies for effective control of LSD.

Experimental Pathogenesis Study of Low Pathogenic Avian Influenza (LPAI) H9N2 Infection in Sonali Chicken in Bangladesh

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Abstract
Low pathogenic avian influenza (LPAI) H9N2 virus is the predominant avian influenza virus in domestic land-based poultry in Bangladesh, followed by HPAI H5N1. The H9N2 viruses have been isolated frequently from commercial poultry flocks, live-bird markets as well as the environment. Although molecular characterization of a large number of Bangladeshi LPAI H9N2 viruses was conducted and several molecular determinants have been identified at present, there is meagre and insufficient data on the pathogenicity of H9N2 viruses in Bangladesh. With the ultimate goal of achieving improved therapeutic and preventive strategies, the project is designed to assess the detailed pathogenicity of Bangladeshi low pathogenic avian influenza (LPAI) H9N2 isolate in experimentally infected Sonali chicken. The LPAI H9N2 influenza virus was isolated from layer during 2021. Six weeks old Sonali chicken (n=20) was inoculated by dropping 0.2 ml of allantoic fluid of H9N2 isolate (10^4 EID50/ml) in both nostrils and eyes. Birds were monitored for clinical and pathological outcomes, and virus shedding for 21 days post-infection (DPI). No mortality and clinical signs were recorded in the infected and controlled Sonali chicken. Experimentally infected Sonali chickens with H9N2 displayed mild congestion and hemorrhage of the trachea and lungs, hemorrhage in small intestine and caecal tonsils throughout the experimental period. Histopathologically, mild to moderate tracheal hemorrhages and congestion in lungs were noticed in infected Sonali chickens. The LPAI H9N2 virus was detected in the trachea, lungs and cloacal swab of infected Sonali chicken by RT-qPCR during the experiment course. The viral shedding was detected up to 21 DPI in trachea, lung, and cloacal viral shedding was not observed after 10 DPI. This study demonstrated the pathogenic nature of the local LPAI H9N2 isolate in Bangladesh.

Cytoprotective Roles of Antioxidants against Acetaminophen-induced Hepatotoxicity

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Abstract
Drug-induced liver injury is becoming a major concern in public health globally. Acetaminophen (paracetamol) is extensively used as a non-prescribed drug for antipyretic and analgesic drugs both in human and veterinary medicine. Here, we investigate the protective property of antioxidants against acetaminophen-induced hepatotoxicity in mice. A total of 20 mice were randomly divided into four groups as control, the acetaminophen-treated group, the acetaminophen+Vit C group, and acetaminophen+Vit E & Se group. Vit C (100mg/L) and Vit E (@75mg/L +Se@0.25mg/L) were mixed in drinking water from day 1 to 4. Acetaminophen was given by a single intraperitoneal injection @50mg/kg body weight on day 4 and sacrificed at 24 hours of post-injection. There were no clinical signs developed after acetaminophen injection. At necropsy, no gross lesions were seen in the liver and other visceral organs in mice of any group. Interestingly, the level of serum hepatic enzymes such as aspartate transferase (AST) and alanine transaminase (ALT) was significantly increased in acetaminophen exposed mice as compared to treatment-free control mice and no significant difference were seen with APAP-exposed with Vit E-Se and Vit C supplemented mice. Microscopically normal histoarchitecture of the liver was seen in the control liver. Hepatic lesions characterized by coagulation necrosis along with marked infiltration of inflammatory cells and mild congestion were seen mainly in the centrilobular area of the liver in acetaminophen-treated mice. However, liver lesions become less or almost no in acetaminophen-exposed mice where supplemented Vit. C or Vit. E-+Se. In immunohistochemistry, huge hepatic macrophages populations was seen after paracetamol administration but did not showed any significance difference in mice of Vit C or Vit. E-Se group. Therefore, it can be concluded that acetaminophen may lead to acute liver dysfunction and Vit. E-Se and Vit C have a cryoprotective role against acetaminophen-induced liver toxicity.

Poultry *Salmonella* Vaccine Protocol and Efficacy Determination up to Last Stage of Laying along with Molecular Characterization, Sequencing and Phylogenetic Analysis of Isolates of Poultry *Salmonella*

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Abstract
The present investigation was designed to develop a protocol for rearing of *Salmonella* -free poultry flock. Biosecurity and vaccination with potent *Salmonella*-vaccines are one of the important tools for *Salmonella* infections control and prevention. Birds were divided into two groups, one group (n=20) as vaccinated challenged and another group (n=20) as unvaccinated challenged. Vaccination was performed with fowl typhoid live lyophilized (Korea) vaccine (0.2 ml, s/c) containing 2×10^7 CFU of bacteria at 16 and 18 (booster dose) weeks after 6 months interval at 42, 66 and 90 weeks. Both groups of birds were also infected with challenged oral dose containing $2\times2\times10^7$ CFU of bacteria at 2 weeks later at each time point of vaccination in both vaccinated and unvaccinated challenged groups of birds. The used methods were morbidity and mortality; ELISA test; gross and histopathology. In unvaccinated challenged birds morbidity and mortality was 50% and 25% at 18 weeks to onward; 53% and 33% at 42 weeks and onward; 50% and 0% at 66 weeks and onward while sudden morbidity and mortality 100% and 100% due to AI at weeks 76. In vaccinated challenged group of birds, morbidity and mortality was 0% and 0% at each time points while sudden morbidity and mortality 100% and 100% at 76 weeks due to AI confirmed by real time PCR and Histopathology. Gross and histopathology have been discussed in the text. ELISA test at 18, 42, and 66 weeks in both vaccinated and unvaccinated birds showed negative OD value. The limitation of molecular characterization of *Salmonella* isolated from last time point could not performed due death of all birds by AI before the scheduled time point 90 weeks. In conclusion, a vaccination protocol against *Salmonella* vaccination at 6 month interval was ineffective.

Investigation of Respiratory Disease Outbreaks of Poultry in Bangladesh Using Two Real-time PCR Based Simultaneous Detection Assays

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Abstract

In the event of field surveillance of a disease outbreak, molecular approaches such as qPCR-based simultaneous detection are effective for rapid and sensitive screening of pathogens. In the current study, we have applied two different detection assays; one for simultaneous detection of avian influenza virus (AIV; M gene) and subtyping (H5, N1, H9, N2) using TaqMan probe chemistry (TaqMan multitarget), and another for simultaneous detection of Newcastle disease virus (NDV), infectious bronchitis virus (IBV) and infectious laryngotracheitis virus (ILTV) using SYBR Green chemistry (SYBR Green multitarget). Surveillance of tissue (n=158) and oropharyngeal swab (206) samples from multiple poultry flocks during the years April 2020–July 2022 revealed that 48.9% were positive for respiratory infections, of which 17.2% positive for NDV, 25.5% for AIV, 9.9% for IBV, and only one positive (0.3%) for ILTV. Among the AIV, 35% were highly pathogenic subtypes H5N1 and 65% were low pathogenic subtypes H9N2. Co-infections of two to three respiratory viruses were also accurately detected. Finally, respiratory viral pathogens are quite common in Bangladeshi poultry and can be successfully detected using multitarget simultaneous RT-qPCR assays adopted in the current study. Increased mass surveillance along with molecular characterization of circulating respiratory viral pathogens is crucial to controlling the epidemic and saving the Bangladeshi poultry industry.

Identifying Level of Zoonotic Diseases Prevailing in the Local Animal Meat Market

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Abstract

In Bangladesh, the meat markets are mostly neglected and slaughtered animals receive minimal attention from the public health standpoint. The antimortem facilities at slaughterhouse are inadequate, therefor, little ante-mortem assessment of animals prior to slaughter was carried out. Consequently, humans are frequently exposed to zoonotic pathogens. This study was attempted to develop/ adapt technologies to detect zoonotic diseases in cattle, sheep, and goat and keep surveying the chance of emerging any zoonosis from slaughter houses of Mymensingh city. In this study a total of 25 slaughtered cattle and 25 slaughtered goats from different slaughterhouses were randomly investigated, gross changes observed in visceral organs was recorded, collected liver, lungs, kidneys, spleen, lymphnodes, for histopathology and polymerase chain reaction (PCR) detection of diseases. The diseases targeted were human, bovine and avian tuberculosis, brucellosis, leptospirosis, listeriosis, toxoplasmosis, Q fever, salmonellosis and Shiga toxin-producing *E. coli* (STEC/ O157:H7). Gross examination revealed tuberculous nodules in lungs and liver of two cattle and caseous lymphadenitis with dystrophic calcification in four goats. PCR carried out with the samples and tested for various zoonotic pathogens, two Holstein Frisian cattle was infected with M. bovis (amplified 600bp fragment of MPB83 gene) and five with Corynebacterium pseudotuberculosis (16sr RNA/ 632bp). The both the cattle and goats were found to infect with deadly zoonotic pathogens and shading infection at markets and consumers. Investigation of other diseases is in progress. It needs routine surveillance of zoonotic diseases at slaughter and needs preslaughter investigation of meat producing animals to minimize risk of zoonosis.

Bangladeshi Farmers' Awareness and Attitudes Towards Lameness in Relation to Cow Welfare and Milk Yield in Dairy Farms

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Abstract
Lameness is a painful disease, which negatively impacts dairy cow production and welfare. Bangladeshi dairy farmers often underestimate lameness occurrence, and they lack knowledge of lameness-causing risk factors and foot health management. The objectives of this study were to estimate the prevalence of lameness, identify the risk factors associated with lameness, and assess the effect on milk production of lactating cows among dairy herds. A cross-sectional study was conducted on randomly selected 643 cows from 30 dairy herds in Pabna and Sirajganj districts. A pretested structured questionnaire, direct observation, and examination of animals were the main tools for collecting information from respondents and determining risk factors regarding different lameness grades. Data were collected from farmers, with inclusion criteria of having at least five cows with dairy farming experience of more than six months. Animals were observed in motion to detect abnormalities by locomotion scoring. The logistic regression was applied to assess the prevalence of lameness and its association with potential risk factors. On the first visit, the farmers were requested to answer a questionnaire on lameness knowledge and their farms' management. All lactating cows (n = 643) on each farm were scored for locomotion by a Veterinarian and farmers (n=60) were asked to estimate the number of lame cows present on their farms at each visit. The ratio of farmers' estimated prevalence and the veterinarians' observed prevalence (Farmer's Detection Index; FDI) was calculated. On average, farmers underestimated lameness prevalence during both visits except for severe lameness. The median prevalence of lame cows assessed by veterinarians and farmers was 21.82% and 14.25%, respectively. Farmers (100%) agreed that lameness induces pain and cows feel it, but interestingly 36.52% of farmers don't think that lameness can reduce milk production. Most of the farmers (78.5%) supported the requirement for alleviating unnecessary pain, but they do not call Veterinarians immediately. Farmers (82.48%) used anti-inflammatories/analgesics and antiseptic hoof wash as treatment remedies by themself and no one mentioned the adoption of regular preventative measures and records for lameness in their herds. 100% of farmers reported having no training on lameness management and cited an overall lack of veterinary support to control lameness on their farms. The results indicate that lameness exists in studied areas due to a lack of farmers' knowledge and awareness. Therefore, farmers' awareness regarding the impact of lameness and management practices of lactating cows should be improved to reduce the prevalence of lameness.

Molecular Detection and Characterization of Mobile Colistin Resistance Gene Carrying *Aeromonas* spp. Isolated from Retail Foods in Mymensingh District

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Abstract
Mobile colistin resistance (MCR) in bacteria is an emerging issue. There is no report of *mcr* carrying *Aeromonas* spp. isolated from retail foods in Bangladesh. Therefore, this study was carried out to determine the prevalence of *mcr* carrying *Aeromonas* spp. from retail foods in Mymensingh district, Bangladesh and their characterization. Aeromonas spp. was isolated from chicken meat, fish, and milk, and identified by PCR. Mcr-1 gene and virulence genes were detected in the isolates by PCR. Minimum inhibitory concentration (MIC) for colistin (CST) by broth microdilution method and antimicrobial susceptibility testing of the isolates by disk diffusion method were carried out. Prevalence of *mcr-1* gene carrying *Aeromonas* spp. was 30 % (15/50) in chicken, 23 % (8/35) in fish and 10 % (2/20) in milk. No other tested *mcr* gene variants (*mcr-2* to-*4*) were detected. The MIC of CST was determined to be 80% (12/15) and 75% (6/8) of the *mcr-1* gene carrying *Aeromonas* spp. isolated from chicken and fish, respectively had an MIC of 8-16 µg/ml whereas 100% (2/2) of the isolate from milk showed MIC of 4-8 µg/ml. Most of the *mcr-1* gene carrying isolates from chicken meats, fish and milk were resistant to TET, AMP (80%-

100%). Apart from multidrug resistance (MDR), extensive MDR was detected in *mcr-1* gene carrying *Aeromonas* spp. irrespective of sample's origin. In addition, virulence gene profiling indicated that among five important virulence genes (*aer act, hly, ahyB, lip* genes) tested by PCR, *lip* gene was detected in all *mcr-1* gene carrying *Aeromonas* spp. irrespective of sample's origin. Importantly, prevalence of *aer act, hly, ahyB* genes were 25% (2/8) in *mcr-1* gene carrying isolates from fish. In conclusion, prevalence of pathogenic MDR *mcr-1* gene carrying *Aeromonas* spp. in retail foods (which is the first report in Bangladesh) might be risk for public health.

Welfare Assessment and Animal Handling by Butchers at Local Slaughter Houses in Mymensingh District, Bangladesh

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Abstract
The objective of this study was to assess the pre-and -post slaughter handling of animals by butchers and evaluation of welfare of animals at local slaughter houses of Mymensingh district in Bangladesh. To achieve the objectives, this study was carried out at local slaughterhouses of 10 Upazilas in Mymensingh district. A pre-structured questionnaire was conducted for half an hour with butchers. The welfare data of animals which were subjected to slaughter was collected by direct observation and examination. Through this study, an overall poor animal welfare was detected; mainly due to lack of awareness and absence of knowledge in animal welfare. Most of the animals were transported from far away to slaughterhouses by truck and pick-up van; other vehicles like auto-rickshaw were also used. The small ruminants such as sheep and goats were transported by local vehicle (11 %) and auto-rickshaw (3 %). Small ruminants were kept in a lairage for 1 to 2 days but most of the large ruminants (cattle) were slaughtered upon arrival. About 70 % of animals were moderately healthy and the majority (93 %) of the animals was free from lameness. In addition, the present study showed that only 1-7 % of animals had skin lesions on different body parts and the majority of animals showed dirty conditions in different parts of the body. Few animals showed nasal and ocular discharge before slaughtering. There was no regular veterinary inspection before slaughtering in the studied slaughterhouses. About 85% slaughter houses had mixed type like pacca, kaccha and semi-pacca lairage but most of them had no bedding materials and floor conditions were dirty. Jute rope was the most frequently used material for casting animals in most of the slaughterhouses. Most of the slaughterhouses in this study followed the halal method for slaughtering animals. The compromised welfare situation of slaughtered animals was observed mainly during transport, at lairage and pre-slaughter handling of the animal.

Factors Contributing to the Prevalence of Dairy Cow Lameness in Selected Milk Shed Areas of Bangladesh

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Abstract
Lameness is a condition characterized by an alteration of gait resulting from pain caused by injury or disease to the hoof or limb. Lameness is a common problem in dairy cows and can greatly affect the welfare and productivity of the animals. In spite of the apparent serious impact of lameness on the performance of cattle and recent growth in the dairy sector, little attention has been drawn to the study of lameness in Bangladesh. In addition, Bangladeshi dairy farmers often underestimate lameness occurrence, and they lack knowledge of lameness-causing risk factors and foot health management. Therefore, the objectives of this study were to estimate the prevalence of lameness, identify the risk factors associated with lameness, and assess the effect on milk production of lactating cows among dairy herds. A cross-sectional study was conducted on randomly selected 643 cows from 30 dairy herds in Pabna and Sirajganj districts, the highest milk-producing areas in Bangladesh. A pretested structured questionnaire, direct observation, and examination of animals were the main tools for collecting information from respondents and determining risk factors regarding different lameness grades. Data were collected from farmers, with inclusion criteria of having at least five cows with dairy farming experience of more than six months. Animals were observed

in motion to detect abnormalities by locomotion scoring. The logistic regression was applied to assess the prevalence of lameness and its association with potential risk factors. Out of 643 dairy cattle examined, 107 (16.64%) showed lameness in different grades, with 58.0% mild, 29% moderate,11% lame, and 2% severe lame. Lameness was significantly associated with floor type, concentrate feed, parity, pregnancy, and milking status ($P<0.05$). The study revealed that lameness mainly occurred due to hoof disorders like overgrowth/lesions/cracks (20.56%) and carpal/tarsal joint lesions (14.95%). Lameness was significantly higher in hind limbs (13%) than in forelimbs (3.5%). In addition, the study revealed that the mean daily milk yield (av. 11.46 L/day/cow) was significantly reduced (av. 9.38 L/day/cow) after the onset of lameness in milching cow. Therefore, farmers' awareness regarding the impact of lameness and management practices of lactating cows should be improved to reduce the prevalence of lameness.

Prevalence Along with Associated Potential Risk Factors of Ill-thrift in Calves in some Selected Areas of Bangladesh

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Abstract
Ill-thrift, characterized by poor growth and development, poses significant challenges to calf rearing and livestock productivity. Because of this pressing concern, the present study was conducted to determine the prevalence and associated risk factors of ill-thrift from January 2023 to December 2023 in calves within Mymensingh District of Bangladesh. A structured questionnaire was administered through face-to-face interviews with farm owners to collect data on potential risk factors for ill thrift, such as age, sex, body condition score, season, biosecurity, regular deworming, etc. Through cross-sectional study a total of 400 calves from 105 farms were randomly surveyed. Fecal samples were collected for parasitic investigations. Calves were considered ill-thrift if their body condition was poor with the following criteria: the presence of a cavity around the tail-head area, no fatty tissue felt between skin and pelvis with supple skin, ends of transverse processes are sharp to touch, and dorsal surfaces can be easily felt, with a deep depression in loin. Out of 400 animals, 84 calves suffered from ill-thrift; thus, the prevalence was 21%. In risk factor analysis using a multivariable logistic regression model, the following factors were significantly ($p < 0.05$) associated with ill-thrift: calves aged up to 4 months, Holstein Frisian breed, previously affected with other diseases, rainy and winter seasons, poor biosecurity on a farm, early weaning less than 45 days, not usage of anthelmintic on a regular basis, presence of internal parasites. Out of 84 calves affected with ill thrift, 20 were affected with Ascariasis, 12 were concerned with Ascariasis + Stomach worm, 32 with stomach worm, 12 were affected with Fasiola + Paramphistomum and 8 with Balantidium coli + Paramphistomum infection. The outcomes of this investigation provide valuable insights for crafting precise interventions and management strategies to reduce the burden of ill-thrift in calves, thereby enhancing the overall health and productivity of livestock in Bangladesh.

Prevalence and Therapeutic Against Brucellosis in Dairy Cattle

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Abstract
Brucellosis is the most widespread bacterial zoonotic disease throughout the world. In animals: mainly affects reproduction and fertility, with abortion and reduced milk yield. In humans: the clinical picture resembles many other febrile diseases, but sacroiliitis and hepato-splenomegaly are the most prominent. The brucellosis has been reported to be associated with bovine infertility for the first time in 1967 from Bangladesh. Recently the reviewed reports showed that the 3.7% sero-prevalence of brucellosis in cattle, 4.0% in buffaloes, 3.6% in goats and 7.3% in sheep and 4.8% in pigs and 4.0% in dogs in Bangladesh. This study was conducted to determine the sero-molecular prevalence and therapeutic responses of combined oxytetracycline and streptomycin with benzyle penicillin in naturally Brucella-infected dairy cross-bred cows. Serum samples of 460 (290 from Central Cattle Breeding and Dairy Farm, 170 from Military Dairy Farm, Savar, Dhaka) lactating cross-bred cows along with their milk samples

were collected randomly. Serum samples were screened for brucellosis with the Rapid Antigen Kit Test, Rose Bengal Test (RBT) and Milk ring test (MRT) and positive samples were tested further with PCR for confirmatory diagnosis. Out of 11 all tests positive cows, of which three had a history of abortion were selected for therapeutic trials with combined long-acting oxytetracycline @ 25 mg/kg BW 3 doses at 24-hour intervals via intrauterine injection and streptomycin @ 20 mg/kg BW with benzyle penicillin @ 40,000 IU/kg 5 doses at 24 hours interval via intramuscular injections. Blood samples of all the *Brucella*-negative control and pre- and post-treatment stages of all the *Brucella*-infected cows were tested for *Brucella* by using PCR. Out of 460 randomly collected serum samples, 18 serum samples 3.9% (95% CI 2.4-6.2) were found positive using RBT and Rapid Antigen Kit Test and 13 of the samples 2.8% (CI 1.5-4.9) were positive respectively. The overall seroprevalence was found to be 3.9% (95% CI 2.4-6.2) using RBT and Rapid Antigen Kit Test and 2.8% (CI 1.5-4.9) using Milk Ring Test, respectively. The odds of brucellosis were 7.4 times (95% CI: 2.5-21.5) higher in cows with repeat breeding than those without repeat breeding. Moreover, the seroprevalence of brucellosis was significantly higher (Odds ratio: 15.7; 95% CI: 5.2-47.4) in cows with retention of fetal membranes than without retention of fetal membranes and base pair of PCR product was 602. However, of the three treated cows, three became pregnant on artificial insemination with a normal reproductive cycle which needs to explore its status in further research. Combined antibiotic with oxytetracycline (I/U) and streptomycin with benzyle penicillin (I/M) against clinical *Brucella* infection showed some encouraging results and can be implemented at field level.

Prevalence of Brucellosis in Large Dairy Herds in Bangladesh

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Abstract

Brucellosis is one of the most important widespread bacterial zoonotic diseases in public health concern. WHO estimates only half a million cases annually being registered as human brucellosis distributed in more than 170 countries with a quarter of cases are unreported with non-specified clinical symptoms which is 10 times higher, and accordingly, the true prevalence is estimated at 5.0 to 12.5 million cases annually. Recently it has been recognized as a re-emerging zoonotic disease in both developing and developed nations where brucellosis was eradicated. As person-to-person transmission rarely occurs in humans, disease control primarily depends on the control of brucellosis in animal populations. Human brucellosis cases are reported be high in regions with a high animal brucellosis prevalence and control of brucellosis in animals greatly reduces the incidence of human brucellosis. The brucellosis has been reported to be associated with bovine infertility for the first time in 1967 from Bangladesh and there're are reports with 3.7% sero-prevalence in cattle, 4.0% in buffaloes, 3.6% in goats and 7.3% in sheep and 4.8% in pigs and 4.0% in dogs. Until today only *Brucella abortus* was reported to be prevalent in both humans and animals in Bangladesh. In this study a cross-sectional study was conducted, involving seven government dairy farms and 67 non-government dairy farms across various districts in Bangladesh, including Sylhet, Chittagong, Barishal, Faridpur, Rajshahi, Bogura, Jashore, Bagerhat, Bhola, Satkhira, Pabna, Sirajganj and Mymensingh. Bulk milk from selected herds was initially screened for brucellosis using indirect ELISA (iELISA) and individual cow milk from positive herds underwent further testing using iELISA. Out of the 131 tested bulk milk samples, 38.9% (51) tested positive and 31% (102 out of 329) of individual cow milk samples were found to be positive for brucellosis. The prevalence of brucellosis at the herd level was Jashore (100%), Sirajganj (75.0%), Satkhira (55.6%), Barishal (50.0%), Faridpur (50.0%), Sylhet (42.9%), Bagerhat (33.0%), Rajshahi (33.0%), Bogura (33.0%), Chittagong (25.0%), Pabna (22.2%), Bhola (17.7%) and Mymensingh (0.0%) while the cow-level prevalence was Jashore (100%), Chittagong (73,7%), Bagerhat (45.2%), Sylhet (36.5%), Rajshahi (28.3%), Faridpur (12.8%), Barishal (8.4%) and Bogura (2.0%). The prevalence of bovine brucellosis in large dairy herds in Bangladesh is notably high at both the herd and cow levels and the study is still in progress.

Effectiveness of Different Treatment Regimens for the Clinical Management of Lumpy Skin Disease in Cattle

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Abstract
The Lumpy skin disease (LSD) is a highly contagious, transboundary, and notifiable emerging viral disease of cattle in Bangladesh. There is no specific treatment exists for LSD because of viral etiology. Herein, we compared four commonly practiced treatment regimens for their effectiveness against LSD in cattle. For this, a total of 160 cattle affected by LSD underwent one of four distinct treatment protocols, with an equal distribution of 40 cases allocated to each treatment category. Four distinct treatment protocols, identified as A, B, C, and D were thoughtfully administered to separate groups of cattle. These protocols were designed using specific combinations of therapeutic agents, each represented by a corresponding letter. In Protocol A, a blend of antibiotics, antihistaminic agents, anti-inflammatory drugs, and an antiseptic body wash was utilized. In the case of Protocol B, a mixture of antiviral medications, antibiotics, antihistaminic compounds, anti-inflammatory agents, and an antiseptic body wash was employed. Protocol C involved a combination of antibiotics, antihistaminic drugs, anti-inflammatory agents, immune stimulants, an antiseptic body wash, and oral neem extract with Sodi-bi-carb. Finally, Protocol D focused on the application of antihistaminic drugs, anti-inflammatory agents, immune stimulants, an antiseptic body wash, and oral neem extract with Sodi-bi-carb. The results demonstrated that Protocol A and protocol B achieved an overall complete recovery rate of 37% and 32.5%, while Protocol C and protocol D exhibited a complete recovery rate of 27.5% and 22% respectively on 21st day. The proportion of cattle with partial recovery was higher in protocol C (48.5%) compared to others. All the protocols demonstrate a comparative reduction in clinical signs and a corresponding increase in animal welfare concerns compared to the diseased phase. Lesion size reduction was observed in all protocols, with protocol C demonstrating a more rapid decline in lesion size during the initial phase of treatment. In comparing aggravation with other infections, a statistically significant higher difference of 17.5% was observed in protocol D, surpassing that of other groups ($p < 0.05$). Protocol D exhibited a higher proportion of non-responsive cases (12.8%) compared to other protocols, raising questions its effectiveness. These findings insights valuable guidance for veterinarians and livestock managers in selecting the most suitable treatment approach to mitigate the impact of this disease on animal health and welfare.

Prevalence of Brucellosis in Large Dairy Herds in Bangladesh

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Abstract
Brucellosis is one of the most important widespread bacterial zoonotic diseases in public health concern. WHO estimates only half a million cases annually being registered as human brucellosis distributed in more than 170 countries with a quarter of cases are unreported with non-specified clinical symptoms which is 10 times higher, and accordingly, the true prevalence is estimated at 5.0 to 12.5 million cases annually. Recently it has been recognized as a re-emerging zoonotic disease in both developing and developed nations where brucellosis was eradicated. As person-to-person transmission rarely occurs in humans, disease control primarily depends on the control of brucellosis in animal populations. Human brucellosis cases are reported be high in regions with a high animal brucellosis prevalence and control of brucellosis in animals greatly reduces the incidence of human brucellosis. The brucellosis has been reported to be associated with bovine infertility for the first time in 1967 from Bangladesh and there're are reports with 3.7% sero-prevalence in cattle, 4.0% in buffaloes, 3.6% in goats and 7.3% in sheep and 4.8% in pigs and 4.0% in dogs. Until today only *Brucella abortus* was reported to be prevalent in both humans and animals in Bangladesh. In this study a cross-sectional study was conducted, involving seven government dairy farms and 67 non-government dairy farms across various districts in Bangladesh, including Sylhet, Chittagong, Barishal, Faridpur, Rajshahi, Bogura, Jashore, Bagerhat, Bhola, Satkhira, Pabna, Sirajganj and Mymensingh. Bulk milk from selected herds was initially screened for brucellosis using indirect ELISA (iELISA) and individual cow milk from

positive herds underwent further testing using iELISA. Out of the 131 tested bulk milk samples, 38.9% (51) tested positive and 31% (102 out of 329) of individual cow milk samples were found to be positive for brucellosis. The prevalence of brucellosis at the herd level was Jashore (100%), Sirajganj (75.0%), Satkhira (55.6%), Barishal (50.0%), Faridpur (50.0%), Sylhet (42.9%), Bagerhat (33.0%), Rajshahi (33.0%), Bogura (33.0%), Chittagong (25.0%), Pabna (22.2%), Bhola (17.7%) and Mymensingh (0.0%) while the cow-level prevalence was Jashore (100%), Chittagong (73,7%), Bagerhat (45.2%), Sylhet (36.5%), Rajshahi (28.3%), Faridpur (12.8%), Barishal (8.4%) and Bogura (2.0%). The prevalence of bovine brucellosis in large dairy herds in Bangladesh is notably high at both the herd and cow levels and the study is still in progress.

Detection, Molecular Characterization and Antibiogram of Methicillin-resistant Staphylococcus Aureus (MRSA) Isolated from Pets and Human in Selective Areas of Bangladesh

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Abstract
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a well-known pathogen with public health significance due to the fact that constant contact with pets can cause clinical illnesses in humans. This study was aimed at ascertaining the molecular epidemiology, prevalence, and antibiogram with molecular detection of MRSA isolated from pet animals, pet owners, and veterinary professionals. Convenient samples, such as pus, nasal, and wound swabs, from 163 pet animals, 157 pet owners, and 14 vet-staff were collected. Initially, gram staining, colony morphology, and biochemical assays were performed to isolate and identify *S. aureus.* PCR primer-specific targeting of the *nuc* and *mecA* genes confirmed the molecular detection of *S. aureus* and MRSA. Disc diffusion methods were used to determine the antibiotic resistance pattern of the MRSA isolates employing different types of antibiotics. Of the 334 samples, 92 (27.54%) were found to be positive for *S. aureus*, while 36 (10.77%) were found to be positive for MRSA. The outcome of the antibiogram indicates that six isolates were 85.72% sensitive to cefradine, and all isolates were 100% sensitive to gentamicin. Dogs MRSA prevalence (15.78%) was higher than that of cats (4.27%) and pet owners (13.17%). The most prevalent (15.78%) MRSA was found in canines at BAU, Mymensingh. Surprisingly, vet-staffs showed positive MRSA. Dogs and cats may act as carriers of MRSA and vice-versa. In order to design practical infection control programs, it will be useful to have access to molecular epidemiologic and baseline data regarding the occurrence, possible pathways of transmission, and risk assessment of MRSA.

Hazard Identification and Characterization of *Campylobacter* spp. in Ready-to-eat and Processed Foods of Chicken and Fish Origin in Mymensingh Municipality

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Abstract
Ready-to-eat and processed foods are frequently contaminated with *Campylobacter* strains and are thought to be the major source of organisms causing human *Campylobacter* gastroenteritis. This study was conducted to evaluate the status of contamination of ready-to-eat and processed foods of chicken and fish origin with *Campylobacter* spp. along with antibiogram in Mymensingh municipality. A total of 150 ready-to-eat and processed food samples of chicken (n=130) and fish origin (n=20), such as chicken sausages, chicken sandwiches, chicken toast, hot dogs, fish fingers, and frozen fish ball were purchased from confectionary, restaurants, and super shops of seven areas of

Mymensingh municipality. *Campylobacter* spp. were isolated and identified by culture onto selective media, Gram staining, biochemical tests, and PCR. The virulence genes *(iam, racR, cad, cdtA, cdtC, flaA, virB11 and pldA*) were identified by mPCR. Antimicrobial susceptibility test of the isolates was done using disk diffusion assay. Forty-two samples were positive for *Campylobacte*r spp., thus the overall prevalence was 28%. The highest prevalence was observed in fish finger (40.0%) and lowest in fish balls (10.0%). Irrespective of sample types, the prevalence in the samples from confectionary, restaurants, and super shops were 31.3%, 27.3%, and 13.3%, respectively. Six isolates harbored one or more virulence-associated genes (*cdtA, cdtC and pldA*). The highest resistance was observed to clindamycin (92.9%) followed by cefotaxime and colistin (69%), and the lowest to gentamicin (19%) followed by chloramphenicol and streptomycin (23.8%). Notably, 81% of isolates were multidrug-resistant and 11.9% were extensively drug-resistant. The contamination of a variety of ready-to-eat and processed foods with *Campylobacter* spp. may indicate that these products can act as possible vehicles for dissemination of food-borne campylobacteriosis.

Multidrug Resistant Extended-spectrum β-lactamase Producing *Salmonella* from Retail Chicken Meat in Bangladesh

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Abstract

Retail chicken meat contaminated with extended-spectrum β-lactamase (ESBL) producing *Salmonella* spp. poses a health risk for consumers. A cross sectional live bird market (LBM) survey was conducted to determine the prevalence, and extent and distribution of phenotypic as well as genotypic resistance pattern of *Salmonella* spp. in retail chicken meat and LBM sewage samples from 32 LBMs of 16 upazilas of 8 districts in 4 divisions of Bangladesh. *Salmonella* spp. were identified by culture-based and molecular methods, and subjected to antimicrobial susceptibility testing, and ESBL- *Salmonella* spp. was screened by double disk synergy test. Genes encoding for β-lactamase and plasmid-mediated quinolone resistance (PMQR) were investigated by multiplex PCR. ESBL-producing *Salmonella* spp. was found 77.5% in retail chicken meat and 81.8% in LBM sewage. Multidrug resistance (MDR) was observed in 99.4% and 100% of retail chicken meat and LBM sewage samples, respectively. Notably, three isolates of *Salmonella* spp. from retail chicken meat showed possible extensively drug resistance. All isolates of *Salmonella* spp. harbored *bla*TEM gene. The *bla*CTX-M-1 gene was detected in 2.8% of *Salmonella* spp. from retail chicken meat. The *qnrA* gene was present in 11.2% of *Salmonella* spp. from retail chicken meat. The *qnrB* gene was detected in 2.2% of *Salmonella* spp. from retail chicken meat. Moreover, 19% of *Salmonella* spp. from retail chicken meat harbored *qnrS* gene. In addition, the *qnrS* gene was also present in 38.1% of *Salmonella* spp. from LBM sewage samples. This study indicates that ESBL–*Salmonella* spp., most of them MDR, are highly prevalent in retail chicken meat and LBM sewage in Bangladesh. Therefore, it is important to ensure the good hygienic practices during slaughtering and processing of chicken in the retail market and to monitor the resistance continuously. Urgent attention is needed, including strengthening antimicrobial stewardship and surveillance programmes in poultry production in Bangladesh.

Monitoring of Udder Health of Dairy Cows: Farmers' Perception and Engagement, Associated with Major Gram-positive Bacterial Pathogens

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Abstract

The objective of this study is to assess dairy farmer's knowledge, attitude, and practices (KAP) regarding farm hygiene and biosecurity, udder health, and mastitis, and to correlate KAP with the occurrence of major Gram-

positive bacterial pathogens (*Staphylococcus* spp. and *Streptococcus* spp.). Data and 206 samples (milk, teat swab, and floor space swab) were collected from 12 farms, and 24 cows in Trishal and Shahjadpur upazilas. *Staphylococcus* spp. and *Streptococcus* spp. were isolated and identified based on the cultural, biochemical, and molecular findings. Antibiogram of isolates against 10 antimicrobials was performed by disk diffusion method. The bivariate correlation was performed to identify the association between KAP of farmers and the occurrence of pathogens. The overall prevalence of *Staphylococcus* spp. and *Streptococcus* spp. was 61.2% and 38.3%, respectively. According to sample type, the prevalence of *Staphylococcus* spp. in milk, teat swab, and floor space swab was 60.4%, 61.5%, 64.3%, and the prevalence of *Streptococcus* spp. was 38.5%, 36.5%, 50%, respectively. The KAP score was significantly negatively correlated with the occurrence of both *Staphylococcus* spp. and *Streptococcus* spp. The highest resistance was observed to erythromycin (40%) followed by ceftriaxone (39.2%) and the lowest to vancomycin (3.2%) followed by clindamycin (8.8%) in case of *Staphylococcus* spp. and for *Streptococcus* spp. the highest resistance was observed to clindamycin (67.1%) followed by erythromycin (64.6%) and the lowest to levofloxacin (2.5%) followed by ciprofloxacin (12.7%). Farmers must enhance their management practices, knowledge, and, attitude to reduce infections and improve udder health.

Prevalence and Characterization of Mobile Colistin Resistance Gene Carrying *Klebsiella pneumoniae* Isolated from Retail Foods and Environment in Mymensingh District

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Abstract
Emergence of mobile colistin resistance (mcr) carrying *Klebsiella sp* in retail food is alarming for public health worldwide. Prevalence of *mcr* carrying *Klebsiella pneumoniae* from retail foods and environment together has not yet been well investigated in Bangladesh. Therefore, this study was designed to determine the prevalence of *mcr* carrying *K. pneumoniae* isolated from retail foods and environment in Mymensingh district and characterize them for antimicrobial resistance (AMR) pattern, serotype and virulence profile. During the study period of February, 2022-January 2023, a total of 250 samples including beef (100), fish/shrimp (50), vegetables (50), soil (25) and irrigation water (25) samples were collected from different upazilas of Mymensingh district. *K. pneumoniae* was isolated and identified as per standard methods. Detection of *mcr* genes, virulence genes, serotyping and clonal relationship among the *mcr* carrying isolates were done by gene specific Polymerase Chain Reaction. Moreover, colistin resistance pattern by microdilution method and other AMR patterns by disk diffusion method were determined. In this study, prevalence of *mcr-1* carrying *K. pneumoniae* was found in fish (36%), irrigation water (30%), beef (26%) and soil (23%) whereas prevalence of *mcr-2* carrying *K. pneumoniae* was found only in beef (8%). However, no clonal relationship was found among the isolates from different sources. Minimum inhibitory concentration for CST ranged from 4 to 32 µg/ml in the *mcr* carrying isolates. The isolates showed 100% resistance to ampicillin followed by azithromycin (50-90%) and imipenem (50-80%). Prevalence of virulence genes including *rmpA* (18%, beef), (25%, irrigation water) and *wcaG* (24%, beef), (34%, fish), (34%, soil) were determined. Only K5 serotype could be determined in the isolates from beef (59%) and fish (34%). High prevalence of multidrug drug resistant pathogenic *mcr* carrying *K. pneumoniae* was found in the isolates from all the sources indicated the potential risk for public health.

Somatic Cell Count Based Surveillance of Bovine Mastitis at Baghabari Milk Shed Areas of Bangladesh

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Abstract
The objectives of this study were to compare the prevalence of bovine subclinical mastitis (BSCM) in Bathan and non-Bathan areas, identify risk factors for BSCM at cow level, and estimate economic losses due to BSCM. A total

of 965 and 2209 milk samples along with data were collected during the Bathan and non-Bathan periods, respectively. BSCM was detected by counting somatic cells and a cow was considered SCM positive if its SCC exceeded 100,000/ml of milk. The prevalence of SCM was compared between the two periods. Risk factors for SCM at the cow level were identified using a multiple linear regression model, with natural log-transformed SCC as the outcome variable. A linear regression model was employed to estimate milk yield loss per unit increase in SCC, considering milk yield as the outcome and SCC as the explanatory variable. The overall prevalence of SCM in the non-Bathan and Bathan periods was 70% and 76%, respectively. The prevalence of SCM was significantly higher in cows with a lactation stage >5 compared to those with a lactation stage ≤ 5. Additionally, the prevalence of SCM was significantly higher in cows with a history of clinical mastitis > 2 times than in those without such history. The mean SCC in non-Bathan and Bathan periods was 454,383 and 429,064 per ml, respectively. The mean milk yield in non-Bathan and Bathan periods was 9.18 and 9.78 liters per cow per day, respectively. Daily milk yield loss per 1000 cows was 139 liters and 240 liters in the Bathan and non-Bathan periods, respectively. Milk yield loss per 50,000 increases in SCC was 163 ml in the Bathan period and 265 ml in the non-Bathan period. The extensive management system during the Bathan periods potentially increases milk yield, decreases somatic cell count, and reduces milk yield loss.

Efficacy of Probiotic Supplement in the Treatment of Bovine Subclinical Mastitis

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Abstract
Subclinical mastitis (SCM) causes great economic loss in the dairy industry due to higher incidence along with invisible detrimental effects. Probiotics offer a promising alternative to antibiotics for preventing mastitis and potentially mitigating the emergence of antibiotic-resistant bacteria. In this study, we investigated the efficacy of a probiotic Lactobacillus acidophilus in the treatment of subclinical mastitis in dairy cows. The study was conducted on a total of 50 lactating crossbred dairy cows with SCM which were screened through the California Mastitis Test (CMT) and Draminski mastitis detector in Muktagachha upazila of Mymensingh district. Direct interviews with farmers and physical examination of the cows were performed for data collection. The therapeutic effect of probiotic Lactobacillus acidophilus supplementation on SCM was evident through a gradual reduction in the number of somatic cell counts in the study cases over the period. Similarly, the changes in milk electrical resistance, as measured by the Draminski Mastitis Detector, showed a decreasing trend, suggesting a positive response to the probiotic treatment. The average milk production gradually increased and the dynamics of milk SCC decreased after the probiotic treatment. Though probiotic treatments may have varying effects, these clinical trials of probiotic Lactobacillus acidophilus indicated its potential in improving udder health and reducing mastitis incidences. These results reveal that Lactobacillus acidophilus has potential as a probiotic to treat SCM in dairy cows, improving udder health, and maintaining productivity.

Successful Regression of Bovine Papillomas by Daylight Photodynamic Therapy (dPDT) in Cattle

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Abstract
Antimicrobial photodynamic therapy (aPDT) has been proven to be a promising approach to treat wide ranges of infectious diseases. Bovine papillomatosis is a contagious viral infection causing significant economic losses to the

farmers by damaging hides, weight loss, stunted growth, production losses and treatment cost. The present study evaluated the therapeutic efficacy of aPDT against bovine papillomatosis in cattle. For aPDT, methylene blue (MB) solution was injected and sprayed to the wart-mass after diagnosis of bovine papillomatosis in six cattle attended at Veterinary Teaching Hospital, BAU. Then, the cattle were exposed to sunlight for 1 hr. The aPDT efficacy was compared with that of the intramuscul injection of anthiomaline tartrate in another group of three cattle infected with bovine papillomatosis. Out of 6 cattle treated with aPDT, all 6 cattle were completely recovered from papillomatosis. Recovery time was variable according to variable size of the wart-masses. Small warts of 0.5-2 cm diameter regressed after 1 week to 3 weeks. Large warts of 2-5 cm diameter regressed after 4-8 weeks. There was no recurrence of papillomatosis after recovery. Out of 3 cattle treated with anthiomaline tartrate, 2 recovered completely and another 1 did not recovered. The present study suggested that MB and sunlight mediated aPDT could be a convenient, less costly and most effective method to treat bovine papillomatosis in cattle.

Therapeutic Efficacy of Photodynamic Therapy against Mange Mite Infestations in Ruminants

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Abstract

Mange is the severe dermatitis caused by mite infestations in animals. Photodynamic therapy (PDT) is a promising treatment strategy to kill wide ranges of microorganisms including bacteria, virus, parasites ect. The therapeutic efficacy of daylight PDT was evaluated in this study against mange mite infestations in ruminants. Mange was diagnosed by observing the clinical signs and microscopic examinations of mites from collected skin scrapings samples using potassium hydroxide (KOH) solution. After diagnosis, 1 mM methylene blue (MB) solution was sprayed on the affected skin of nine ruminants (cattle, goats) attended at Veterinary Teaching Hospital, BAU. The animals were exposed to sunlight for 1 hour after keeping them in dark shed for 10 min. This treatment procedure was repeated every day until recovery. The dPDT efficacy was compared with that of the treatment with ivermectin in another group of three animals. Out of 9 animals treated with dPDT, all 9 animals were completely recovered from mange. Recovery time was variable according to severity of the disease. Signs of pruritis and other skin lesions started to reduce after 1 week to 3 weeks of starting treatment. Complete hair growth on the infected area was observed after 4 to 8 weeks of starting treatment. Out of 3 animals treated with ivermectin, 0.2 mg/kg body weight, 2 animals recovered and 1 severely affected goat did not recover which later recovered by treating with dPDT. The side effects were not observed in all animals including 2 pregnant cattle. The present study concludes that MB mediated dPDT would be a convenient, less costly and an effective method with less side effects to treat mange in ruminants.

Impact of Saline Water Intake on Heamato-biochemical Parameters in Native Cattle in the Selected Coastal Areas of Bangladesh

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Abstract

Salinity intrusion is one of the major environmental issues in the coastal areas of Bangladesh which has a significant effect on the livestock production. This study was undertaken to determine the impacts of drinking saltwater on the heamato-biochemical parameters in cattle in the selected coastal areas of Bangladesh. A total of 60 native cattle (male and female) age ranging from 6 months to 12 years were randomly selected from one upazila as control area (Mymensingh Sadar, Mymensingh) and two upazilas in the coastal belt (Koyra, Khulna and Shubarnachar,

Noakhali). In order to account age effects, all cattle were categorized as young (less than 1 year) and adults (older than 1 year). Blood samples were collected from the selected cattle and blood parameters were measured. Water samples from the selected study areas were collected randomly for chemical analysis. Serum potassium, aspartate amino transferase (AST) and uric acid were significantly (P<0.05) higher in cattle of Koyra while comparing to Shubarnrachar and Mymensingh Sadar. Whereas serum alanine aminotransferase (ALT), urea, creatinine, sodium and chloride were significantly higher (P<0.05) in cattle of Subarnachar than Koyra and Mymensingh Sadar. Interestingly, there was no significant difference in uric acid, potassium, sodium, and chloride between the cattle of Mymensingh Sadar and Shubarnachar. All measured blood parameters except uric acid were higher in young male cattle. RBC and platelet level were significantly (P<0.05) lower in the cattle of Koyra compared to Shubarnachar and Mymensingh Sadar. On the other hand, hemoglobin, and packed cell volume (PCV) level were significantly (P<0.05) lower in the cattle of Shubarnachar. in this study, the white blood cell (WBC) and it's components such as neutrophil, lymphocyte, monocyte, eosinophil and basophil level did not vary significantly (P>0.05). Inclusion of drinking saltwater altered some heamato-biochemical components in some coastal areas in Bangladesh.

Physiological Adaptation of Indigenous Sheep to Increased Water Salinity at the Coastal Areas of Bangladesh

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Abstract

Bangladesh is one of the countries most susceptible to climate change's effects and is most likely to experience its negative repercussions. Due to water salinity, it is important to understand the animals' physiological capacity for salinity tolerance. As a result, the study investigated the adaption mechanisms or methods for preserving salt-water balance in sheep when drinking saline water for an extended period in Bangladesh's coastal districts. A total of 150 sheep (both male and female), ages ranging from 1 to 6 years were randomly selected from five different upazillas of two coastal districts namely Khulna (Dacope and Koyra), Noakhali (Subarnochar, and Hatia), and Mymensingh (Sadar) as control (30 sheep from each area). All sheep were categorized into two groups: young (<2 years) and adults (>2 years). The blood parameters were measured. Serum sodium, potassium, chloride, ALT, AST, urea, uric acid, and creatinine were significantly (P<0.05) differed among the areas. In Koyra where animals drank higher concentration of saline water, significantly higher (P<0.05) values were observed in serum creatinine, uric acid, urea, AST and potassium, whereas sodium and chloride were significantly (P < 0.05) higher in sheep of Hatia than other four areas. Haematological parameters did not differ significantly except Hb and platelets in sheep of Koyra. No significant differences were observed between the young and adult as well as male and female sheep. However, in Dacope, Koyra and Hatia, adult sheep had higher serum sodium and chloride than young sheep. The histopathological appearance of the kidneys in sheep of coastal areas showed tubular necrosis, dearrangement, severe hemorrhage with accumulation of water within tubule, and vacule formation. It is concluded that sheep in coastal regions may adapt to higher saline levels by altering their kidney function and have varying salt tolerance capacities depending on their age and sex.

Therapeutic Efficacies of Different Wound Healing Materials Traditionally used by Rural Farmers in Bangladesh

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Abstract

Across the Indian subcontinent, herbal remedies and other natural treatments are easily available for the treatment of farm animals. The aim of the study was to evaluate the therapeutic effectiveness of different materials that are historically used in Bangladesh to treat wounds. There were 36 incised wounds on the twelve Blank Bengal goats (three on each animal). Three groups of goats were used: Group A served as the control group, Group B received turmeric paste treatment, and Group C received cotton ash treatment. Data were collected on follow-up from the first

postoperative day to the twenty-first. Additionally morphological features such as wound swelling, the width of the sutured area, wound contractions, and the length of time the wound took to heal were recorded. On days 1, 4, and 8 of the operation, blood samples and tissue biopsies were collected for hematological and histological investigation. When comparing wounds treated with cotton ash to other groups, the contraction (0.27±0.01 mm), swelling of the suture area (0.37±0.03 mm), and elevation line of the suture (1.43±0.05 mm) were all lowest ($P<0.05$). According to histological investigations, on day eight of group B's wound, epithelial regeneration and healthy collagen fiber appear in the subcutis whereas the keratin layer of epidermis appears thick and huge accumulation of carbon particles beneath the muscularis layer in the wound treated with ash. We may conclude that goat skin lesions can be treated with cotton cloth ash in addition to other herbal medicines. Ash ointment and turmeric paste are both beneficial, but turmeric paste accelerates recovery more quickly.

Leukocyte-and Platelet-rich Fibrin (L-PRF): an Alternative to Antibiotic for the Treatment of *Staphylococcus aureus* Induced Infected Wound in Animal Model

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Abstract
This study has been designed to find out the effectiveness of heterologous Leukocyte-and platelet -rich fibrin (L-PRF) infectious wounds in rabbits. A total of 12 surgical wounds were made in rabbits under two groups; L-PRF (group A), phosphate buffered solution (PBS) (group B, control). In group A or L-PRF group- freshly prepared L-PRF was applied topically on the wound twice a week, group B or control group- wounds received sterile saline only. Follow up information was recorded from day 0 to day 21 postoperatively. Morphological characters such edema, inflammatory swelling, pain sensation, crust formation, wound contraction and complete healing time were observed. Histological evaluation like local inflammation, collagen deposition and re-epithelialization were analyzed at days 7, 14 and 21 after skin injury. *In vivo* and *in vitro* antibacterial activity of L-PRF were also evaluated. We have shown that L-PRF was highly effective in reducing the wound area and accelerating wound closure compared to untreated control wounds. Mean days to heal completely were 15 days for L-PRF and in the control group, it took 21 days to get similar results. Histopathological study revealed the presence of marked inflammation with irregularly arranged fibroblast in samples collected at day 7 in control group whereas these features were markedly improved in the L-PRF treated group. There was distinct thickening of epidermis and thick keratin layer in L-PRF group while these features were markedly inferior in control group at day 21. Serum biochemical analysis of L-PRF group revealed improved activities of selective biomarkers which are known for functional activities of vital organs. Our results revealed that L-PRF ameliorated septic dermal wound healing by modulating inflammation and angiogenesis, collagen synthesis and re-epithelialization.

Wound Contraction Effect and Anti-bacterial Properties of Platelet-rich Plasma on Induced Infected Cutaneous Wound by Methicillin-resistant *Staphylococcus aureus* in Goats

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Abstract
The research has been conducted in goats to determine the wound potentials and antimicrobial properties of platelet-rich plasma (PRP) gel for the treatment of *Staphylococcus aureus*-induced septic wounds. A total of 12 surgical wounds were made in goats under two groups; PRP (group A), phosphate buffered solution (PBS) (group B, control). Each wound was 8 mm in diameter. All the wounds were infected with *Staphylococcus aureus* (5×10^5CFU/ml) and covered with sterile vaseline gauze for 72h. After 72h of Staphylococcus inoculation, treatment

started. Freshly prepared PRP was applied topically once daily twice a week in animals of group A. Similar treatment was carried out in group B using sterile PBS. Follow-up information was recorded from day 0 to day 21 postoperatively. The mean days to heal completely were 15 days for PRP and in the control group, it took 21 days to get similar results. Histopathological study revealed the presence of marked inflammation with irregularly arranged fibroblasts in samples collected on day 7 in the control group whereas these features were markedly improved in the PRP-treated group. *In vitro* antibacterial activity showed that undiluted PRP effectively inhibited Staphyloccocal growth in 96 plate model. Serum biochemical analysis of PRP group revealed improved activities of selective biomarkers which are known for the functional activities of vital organs. Our results revealed that PRP ameliorated septic dermal wound healing by modulating inflammation and angiogenesis, collagen synthesis and re-epithelialization. It also proved potent against pathogenic microorganism *in vivo* and *in vitro*. Our data provide a preliminary theoretical foundation for the clinical administration of PRP in septic wound healing and skin regeneration.

Role of Heat Shock Proteins (HSPs) in Immunomodulation, Adaptation and Productivity of Indigenous Goats under Heat Stress Condition

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Abstract

Heat Shock Protein (HSP) is an ideal candidate genetic marker for selection of goats with better climate resilience, immune response and superior performance. This study was performed to evaluate the effect of heat stress on the physiological parameter, haemato-biochemical parameters, endocrine, and carcass quality. The ultrasonic scanning of the subcutaneous fat thickness (SFT), longissimus dorsi muscle, rib-eye muscle, and extensor carpi radialis muscle and expression profile of Heat Shock Protein (HSP) 60, 70, and 90 mRNA in skeletal muscle and peripheral blood mononuclear cells (PBMC) in indigenous goats during summer and winter season were also investigated. A total of 32 indigenous goats were used in this research and they were reared in the Animal Research Farm of the Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh. During the experiment, based on data of ambient temperature and relative humidity, the calculated Temperature Humidity Index (THI) was 30.5± 0.516 in summer and 16. 367 ± 1.51 in the winter season. The results of rectal temperature, respiratory rate and heart rate showed statistically ($P< 0.05$) significant differences between summer and winter seasons and times of recording (morning and afternoon). Among all biochemical parameters, the level of some parameters such as glucose, AST, urea, phosphorus and calcium was decreased significantly ($P<0.05$) in winter season as compared with summer season. Haematological examinations showed the value of PCV and WBC were increased significantly ($P<0.05$) in winter season as compared with summer season. The changes in other blood components were not statistically significant. During the study period, the changes in serum hormone concentration of cortisol, T3 and T4 were not statistically significant in summer and winter season. In summer season, the mRNA expression was found significantly higher in HSP90 as compared with HSP60 and HSP70. No difference in the ultra-sonographic echogenicity of the longissimus dorsi, rib eye and extensor carpi radialis muscles was observed during summer season. In this study, there was no significant difference ($P>0.05$) in meat quality as well as carcass quality during summer and winter season for effect of heat stress. The histological changes associated with heat stress were evaluated during summer and winter season and results showed no major changes of vital organ such as brain, heart, liver, kidney and lung during heat stress.

Adaptive Capability of Indigenous Versus Exotic Goats as Indicated by Dynamics of Heat Shock Proteins and Endocrine, Biochemical, Immune Responses under High Environmental Temperature in Summer

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Abstract
Goats are most adapted species to all type agro-climatic conditions although they experience stress due to thermal challenges. Environmental stressors such as hypothermia or hyperthermia affect behavioral, physiological and molecular mechanisms. This study was conducted to evaluate the impact of high and low ambient temperature on physiological, biochemical, hormonal changes as well as heat resistant gene responses in indigenous and exotic breeds of goats. Black Bengal and boar goats were used as indigenous and exotic species respectively. The study was conducted in summer (May – August) and winter (December – February). The daily temperature and relative humidity were recorded by digital hygrometer and thermometer installed in the animal shed to calculate the temperature-humidity index (THI). Physiological parameters were recorded once a week during the experimental periods. Blood samples and skeletal muscle samples were collected at 15 days interval in each season. Blood samples were analyzed for haematobiochemical and endocrine changes. Skeletal muscle samples were used to perform real-time PCR to investigate the relative expression of Heat Shock Protein (HSP)60, HSP70 and HSP90. In this study, the temperature humidity index (THI) was 30.5± 0.51 and 16.37 ± 1.51 in summer and winter season respectively indicating that all the animals were in very high heat and cold stress under summer and winter season. The haematobiochemical and endocrine analysis of this study revealed that heat and cold stress in Black Bengal and Boar goats exerted significant alterations in some hematological, serum biochemical and hormonal parameters. There were abundant expression of HSP90 in the skeletal muscle of BB goats in both season but the expression was significantly ($P<0.05$) higher in the summer. Thus, it can be concluded that both heat and cold stress are associated with certain systemic effects in goats and HSP especially HSP90 may have protective effect of thermal stress so as to maintain cellular integrity and homeostasis in goats.

Prevalence of Foot Diseases and Clinicopathological Investigation on Digital Dermatitis in Dairy Cattle in Sirajganj District

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Abstract
Dairy cattle of milk shed areas of Shahjadpur and Sathia Upazilas of Sirajganj district play a significant role in meeting the demand for milk in Bangladesh. However, due to foot diseases, the farmers face a considerable amount of economic loss. The study was carried out to determine the occurrence and risk factors of foot affections in cattle at three unions (Kayempur, Potazia, Dhopadaha) of Shahjadpur and Sathia Upazilas in Sirajganj district which were under the legislation of Milk vita, Baghabari. Surgical cases were physically monitored and retrospective data was collected from the register book of Milk Vita, Baghabari. During the period of study, a total of 25982 surgical affections were recorded in cattle, among them 1662 cattle were affected with different foot diseases. Among the foot affections, digital dermatitis (DD) was widely investigated. Infected tissue samples for histology, blood for serum biochemistry, and infected swab samples for bacteriological study were collected from DD-affected cattle. Among the different surgical affections, the overall occurrence of foot diseases was 61.67% and in foot diseases, the occurrence of DD was 4.51%. The highest occurrence of DD was recorded in female and over 3 years of old cross-bred cattle reared in a free stall housing system. Data from this investigation may help understand the scenario of different foot affections especially DD in dairy cattle to take necessary action against these diseases in this important milk pocket area of Bangladesh.

The Achievement of Double Dose Frozen Semen Insemination in Field Sheep and Nucleus Flock Development through LAP-AI under Public Private Partnership

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Abstract
The work was conducted in the field sheep of Gaibandha districts (Fulchori and Sundorganj) and in the sheep farm of the Department of Surgery and Obstetrics, BAU, Mymensingh. The objectives were to i) observe the production and economic performances viz. pregnancy, lambing rates in ewes and body weight and sale price of produced lambs at 12 months of age, ii) observe the success of nucleus lamb production with Laparoscopic Artificial insemination (LAP-AI). **In the field**, a total of 75 ewes were induced for estrus by i.m. injection of $PGF_2\alpha$ (Ovuprost®, Bayers, New Zealand). Transcervical Insemination (TCAI) using a double dose of frozen semen was performed in 47 estrus-responded ewes within 12-18 hours of the onset of estrus. The objectives parameters were monitored for verification. **In the research station**, for Nucleus flock development, quality ewe lambs (F1 generation) were selected by observing the age and body weight at puberty, onset of estrus, and duration of estrus. The selected ewe lambs (n=25) were synchronized for estrus. The LAP-AI was performed within 20-24 hours of the onset of estrus using chilled semen. **In the field** the ewes responded to induction of estrus was 62.7%, the pregnancy rates were 48.9%, the lambing rates were 86.9%, and the litter size was 1.8. lamb survival rates up to weaning were 83.3%. The growth rates were 101.4±3.69 gm (73.3-140), and the weight at 12 months age varied from 17.6±0.68 (14-30kg). The price at that age was 7010.52±142.83 (5800-8500) Taka. **In the research station,** seventy-six percent (19/25) of ewes responded to induction of estrus. The pregnancy rates with laparoscopic AI were 89.4%. The lambing rates were 100%. Birth weight was 1.35±0.13gm (.95-2.8), lamb survival rate 92.8%, and growth rate was 74.24±5.4gm (46-160gm). The double dose of insemination through the complex cervix using frozen semen increased the pregnancy rates in the field compared with other published literature using a single dose. The performances of nucleus flock lambs produced with LAP-AI were highly satisfactory compared with natural breeding with respect to growth rates and survival rates.

Evaluation of Different Estrus Synchronization Protocols on Lamb Production During Non-breeding Season for Local Ewes

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Abstract
The work was conducted in the sheep research farm and reproduction laboratory in the Department of Surgery and Obstetrics, BAU, Mymensingh. The objective was to determine the effective estrus synchronization protocol in terms of estrus responses and lamb production by comparison among different synchronization protocols during the non-breeding season. One natural service and 3 treatment groups were included in the study, comprising a total of 16 local ewes in 4 groups (n=4). With natural service Group, the comparison protocols were, ii) two times PGF2α injection at 9 days apart and fixed time AI 48 hours of 2nd $PGF_2\alpha$, iii) Ovsynch protocol: Two times GnRH was injection at 9 days apart plus fixed time AI at 64 hours of $PGF_2\alpha$ injection and iv) Co-synch protocol was the same as ovsynch except fixed time AI immediately after 2nd GnRH injection. Both GnRH (Gonasyl Renata Ltd, Bangladesh) and PGF2α (Ovuprost® Bayers, New Zealand) were injected at the dose rate of 0.8ml (175µg) per ewe. The comparison parameters were onset of estrus, estrus intensity, pregnancy, and lambing rate following induction. The estrus response was higher in both ovsynch and co-synch protocol than natural service and double dose PGF2α injection (100 vs 75%). Similarly, effects were observed by the intensity of estrus. The higher intensity of estrus was

confirmed by the increased number of cornified cells (non-nucleated modified cells) during the estrus period. The pregnancy rates were higher in ovsynch and consynch in comparison with natural estrus and PGF2α group (100%). The lambing rates were 100%. The lamb survival rates were higher in the ovsynch group and growth rates were significantly higher in the ovsynch and cosynch group. The results showed that with GnRH induction protocols (ovsynch & co-synch) the estrus response and pregnancy rate were higher than natural and double PGF2α Group during non-breeding season in local ewes indicating the tendency of seasonality. The number of animals until now was smaller and the work is continuing.

Physical Activity During Pregnancy and its Effects on Pregnancy, Colostral Immunity and Lamb/kid's Performance in Small Ruminants

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Abstract
All animals need a healthy pregnancy. Mechanization in agriculture and industry depletes animal pastures. Farms rarely exercise animals. Research shows that prenatal exercise benefits both the mother and fetus. This enhances the mother-fetal unit and benefits moms and children throughout life. Exercise has numerous benefits for pregnant women, but its effects on small ruminants are unknown. We compared goat blood biochemistry before and after pregnancy. The experiment employed 14 healthy non-pregnant and 10 pregnant Black Bengal goats aged 3–4 years and weighed 18–20 Kg. Both pregnant and non-pregnant goats were jugular venipuncture. Chemistry Analyzer Pointcare cV3 analyzed serums after separation. An increased total protein trend ($p>0.05$) in pregnant goats was found. Serum albumin and glucose levels were significantly higher in pregnant goats than non-pregnant goats ($p<0.05$). However, globulin fell. In pregnant goats, reduced serum AST ($p<0.05$) and higher ALT ($p>0.05$) values suggest healthy liver function. Pregnant goats showed significantly greater blood triglycerides and cholesterol ($p<0.05$) than non-pregnant goats. Serum creatinine levels were similar in pregnant and non-pregnant goats. Pregnant goats had significantly greater calcium levels ($p<0.05$) and lower phosphorus ($p<0.05$) than non-pregnant goats. Nine pregnant goats walked 20 minutes at light-moderate intensity in an exercise study. Blood was drawn before and after the activity. Pre- and post-exercise goat parameters were not significantly different ($p>0.05$). Walking raised serum ALP and glucose. Total protein, albumin, globulin, A/G ratio, total bilirubin, ALT, AST, AST/ALT ratio, GGT, total bile acid, creatinine kinase, triglyceride, cholesterol, creatinine, BUN, BUN/CRE ratio, total carbon dioxide, calcium, phosphorus, Ca/P ratio, and magnesium decreased This research could help scientists and veterinarians understand how physical activity during pregnancy impacts black Bengal Goat blood biochemistry. Research with larger sample numbers and different exercise intensities is needed to evaluate how exercise affects pregnant goat health.

Physical Activity Status of Dairy Cows in Bangladesh and its Impact on Reproduction and Fertility

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Abstract
Physical activity has several health benefits. It boosts reproduction and fertility. Bangladeshi dairy cow activity is unknown. To evaluate dairy cows' physical activity. Thirty-three crossbred and local farms were visited. Farmers were interviewed with a prepared questionnaire, and farm registers were used to obtain farm and animal data. It had 74 local and 181 crossbred cattle. The local breed's breedable male was 19, the crossbred 41. The mean ± SD of milking cows in local and cross-breed farms were 2.555±1.580 and 5.40±5.395, respectively. Local and crossbred farms' overall milk production was 2.083±2.562 and 39.867±47.497 litres, respectively. We found that 78% of animals were under 5 years old, and 22% were above 5. Similarly, 74.5 % of local breed animals were under 5 years old, and 25.5% were above 5. Sixty-six percent crossbreds and 58.8% local breeds had 1–4 parities. Additionally,

11% of local and cross-bred animals had more than four parities. The majority of crossbreeds (67%) were lactating. Furthermore, 55% of cross-breeds and 62.7% of local breeds were pregnant. Crossbreds had 13% reproductive disease compared to 4% for native breeds. Crossbred cows rarely graze surrounding pastures. Only 12% of crossbred cows had little grazing or activity. Meanwhile, 96.1% of local breed cows grazed. Grazing in the field is a form of physical activity. The study found that cross-bred animals had 87% reproductive disease, compared to 3.9% for the local breed. Besides, the pregnancy rate in cross-breed animals is 55 % lower than local breed animals at 62.7 %. Crossbred cows lactated more than locals. Unlike local breeds, most crossbred cows (60%) received commercial and 100% stall feeding. Unlike crossbreds, local breed cows exercised while grazing in the pasture. Our crossbred cows may have lower pregnancy and fertility rates due to less physical activity.

Impact of Climate Change and Soil Content on the Occurrence of Repeat Breeding Syndrome in Crossbred Dairy Cows

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Abstract

Livestock drives Bangladesh's agricultural economy. Thirty-six percent of animal protein comes from livestock, and 75% of our population depends on livestock, directly or indirectly. Profitable dairy farming requires appropriate climate, soil, and animal physiology. Dairy cow reproduction must be ideal to meet demand. Reproductive illnesses impair cattle's reproductive performance and efficiency. Repeat breeding syndrome (RBS) is Bangladesh's serious multifactorial dairy reproductive disease. Studies have documented the incidence of RBS; however, the causes remain unclear regarding our climatic conditions. RBS is increasing in Holstein-Friesian cows. Holstein Frisian is a cold-climate breed that endures a significant temperature range following acclimatization to tropical climates. We lack data on Bangladesh's climate changes. In addition, the soil's mineral concentration directly impacts forage production and feed composition. Climate, soil, and physiology balance is required for optimal dairy cow production. Good reproductive and productive health depends on metabolism and its interplay. How climate and soil affect RBS in dairy cows in Bangladesh has not yet been studied. The study is in progress. Till now, we have registered 105 farms in the Mymeningh and Chittagong regions. Seventy-seven farm data on reproductive disease occurrence and other management data have been collected from the Chittagong region. We found that 4% of the total reproductive and 2% of all diseases are RBS in the Chittagong regions. We must collect further information and experimentation from farms in different areas to conclude the study.

Blood and Plasma Transfusion for the Treatment of Critically ILL Goats

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Abstract

Now-a-days transfusion of blood and plasma become a very essential and life-saving tool in veterinary critical care and emergency medicine throughout the world. This study investigated the clinical and hematobiochemical responses of blood and plasma transfusion in severe anemic goats. From January 2020 to December 2022, a total of 23 anemic goats were admitted in the Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU), Mymensingh. Among them, 12 clinical anemic goats (group A) received fresh whole blood transfusion and 11 (group B) received plasma transfusion. The recipients were selected depending on the clinical and hematological parameters and containing less than 18% PCV with clinical sign of weakness and pale or whitish mucous membrane (anemic). Five healthy goats were used as donors. Desired amount of CPDA-1 (1 ml/7 ml blood) was taken into a 50 ml disposable syringe and blood was collected from the donor through jugular venipuncture. The blood was then transfused @10-12 ml/kg body weight afresh to the recipient or centrifuged for separation of plasma for transfusion. Clinical (heart rate, respiratory rate and rectal temperature), Hematological (TEC, TLC, HB, PCV, Neutrophil, Eosinophil, Lymphocyte, Monocyte), Electrolytes (Na^+, K^+, Cl^-) and Biochemical (ALT, AST, Creatinine, TP) parameters were evaluated before and after at 1st, 7th, 14th, 21th, 28th days post-transfusion. In both the group, total

erythrocyte counts (TEC), packed cell volume (PCV), hemoglobin (Hb) and total protein (TP) were increased significantly ($p<0.05$) at 1st, 7th, 14th, 21th, 28th days of post-transfusion in comparison to pre-transfusion values. However, the hematological parameters were found superior in the animals received blood transfusion. All the animals recovered successfully except one received blood transfusion that was critically ill, emaciated, lateral recumbent and cannot stand, eat or drink. The blood and plasma transfusion was found to upgrade the hematological and biochemical parameters in anemic goats. The transfusion of blood and plasma can be an effective tool for the clinical management of anemic goats.

Efficacy of Different Treatment Regimens in True Anoestrus Dairy Cows of Bangladesh

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Abstract

The study was carried out to evaluate the effect of different therapeutic interventions on estrus induction response and conception rate in true anoestrus dairy cows in Bangladesh. Forty two crossbred dairy cows with ≥90 days postpartum were allocated to 4 groups, viz., GI, GII, GIII, and GIV. All cows were dewormed with bolus Tetranid @ 1 bolus/150 kg orally. A vitamin-mineral mixture was administered to GI, GIII, and GIV for 15 days, while cows of GIII and GIV additionally received a single injection of 500 µg of GnRH analogue intramuscularly and Sepia 30 @ 10 drops orally daily for 10 days, respectively. Whereas, GII cows were only administered 500 µg GnRH analogue. Following confirmation of estrus, cows were inseminated trans-cervically within 14–20 hours of the onset of estrus using good-quality frozen semen. Pregnancy was confirmed by rectal palpation and using a fetal Doppler. Vaginal discharge, moderate to good uterine tone, and the presence of palpable follicles in the ovary were considered the genital changes indicative of oestrus in the study animals. Overall estrus induction responses in GI, GII, GIII, and GIV are 50, 45.45, 83.33, and 72.72%, respectively, and the response in GIII was significantly higher ($P > 0.05$) compared to GII. The post-treatment estrus intervals in cows under the 4 treatment groups were 31.25 ±2.11, 26.80 ± 4.31, 23.60 ± 3.05, and 28.13 ± 4.77 days, respectively. Overall conception rates in GI, GII, GIII, and GIV were 50%, 60, 90, and 75%, whereas service per conception was 3.5, 3.6, 1.89, and 2.83, respectively. However, there was no significant difference. It can be concluded that nutritional, hormonal, and homeopathic interventions can be used to manage true anoestrus in cows. Homeopathic treatment was found to be effective as GnRH with nutritional support in addressing true anoestrus in dairy cows.

Chilled Preservation of Boer-cross Buck Semen in Bangladesh

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Abstract

Goats are regarded as the poor men's cows in Bangladesh. Compared to black Bengal (BB) goats, Boer is popular breed of meat goat in the world. Improvement of BB goats by cross breeding with Boer bucks through artificial insemination may contribute a lot to meat production from goats in Bangladesh. Considering the mentioned facts, the objective of this investigation was to preserve the Boer cross buck semen to optimize the semen preservation technique in Bangladesh. Semen was collected from two adult Boer cross bucks using artificial vagina following standard procedure. After performing routine evaluation with respect to volume, progressive motility, concentration and spermatozoa with normal acrosome, mid-piece and tail, semen was diluted using a TRIS-based diluent supplemented with 10% egg yolk. After dilution, the semen was stored at 4^{0}C at refrigerator for 72 hours. The stored semen was evaluated with respect to progressive motility and spermatozoa with normal acrosome, mid-piece and tail at 24 hours interval up to 72 hours. The volume, progressive motility, concentration and spermatozoa with

normal acrosome, mid-piece and tail of fresh semen varied from 380.0125.5 to 410.054.8 µl, 74.013.9 to 76.06.5 %, 2584.0470.1 to 3542.01961.1 x 10^6/ml and 94.32.3 to 94.90.4 %, respectively. The progressive motility of stored semen decreased gradually (57.215.7 to 60.66.4 % after 24 hours and 34.013.9 to 39.25.4 % after 72 hours) with increased duration of storage at chilled condition. The ingredients of semen extender should be optimized to improve the storage quality of preserved semen of Boer cross buck semen. The work is in progress.

Exploring Stakeholder Perspectives on the Professional Skills of Veterinarians Who Graduated from Bangladesh Agricultural University

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Abstract

Understanding the professions' perceptions in terms of veterinary employability, as the basis for professional, organizational, and individual success is very crucial for Vets of Bangladesh. Therefore, the research project was conducted to facilitate access to accurate information about stakeholder's perspectives on veterinary professional skills, to build a strong evidence base on the expectations of stakeholders in terms of veterinarians, employers, clients, and employees through mixed methods research, and to guide accreditors and policymakers, in aligning outcomes towards the capabilities most important to professional success and satisfaction. A survey of veterinarians involved in a variety of professional activities, animal owners, and employers in Bangladesh was performed. The study involved 67 recent graduates, 52 veterinary practitioners from Bangladesh Agricultural University, 81 clients/farmers/food animal owners, 32 pet and zoo animal owners, 18 veterinary employers, and 37 academicians from various departments of the Faculty of Veterinary Science at Bangladesh Agricultural University. The study found that veterinarians prioritize several attributes, including clinical knowledge, analytical skills, professional commitment, and adaptability. New graduates found these attributes important, with 68.7% valuing them. Practitioners assessed their abilities and found all abilities significant, except cultural sensitivity. Most talents improved at work, suggesting that characteristics and comprehension are essential for professionalism. Veterinary Teachers find all skills important, but teachers were generally satisfied with their current curriculum. Employers found veterinary practitioners BAU as non-judgmental, open-minded, flexible, adaptable, and trustworthy, but unskilled in compassionate animal handling, practical diagnosis, and specialized knowledge. The survey of pet and food animal owners revealed that 62.3% suggested improvements in veterinary professionalism. Owners valued veterinary clinical knowledge, communication, critical thinking, and professional behaviour. They praised BAU graduates for their empathy and good disease diagnosis and treatment abilities. Owners also emphasized the importance of continued education and training in veterinary medicine. The congruency between the stakeholder groups' opinions is the key finding of this study, which would be critical for sustained work engagement and satisfaction, self-esteem, and personal well-being. The examination of this qualitative data shows a noted understanding of the significance of some specific technical and non-technical attributes, which can help for the improvement of curriculum and student support programs in veterinary curricula of the Faculty of Veterinary Science, BAU.

Speeding up Genetic Gain Through Embryo Production and Transfer for Sustainable Improvement of Milk Production in Dairy Cattle of Bangladesh

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Abstract

Embryo transfer (ET) as second-generation Assisted reproductive technology (ART) is a technique that can greatly increase the number of offspring and helps in gaining genetic merits of both males and females. ET is being highlighted as the most remarkable biotechnology and strategic tool due to the establishment of more efficient methods for the superovulation of donors, AI using sex-sorted, embryo retrieval ⁄transfer by low-invasive methods as well as better, simpler and more effective cryopreservation methods. To exploit ET's full potential in Bangladesh,

a reliable *in vivo* and *in vitro* embryo production system, and a dedicated ultrasound-guided ovum-pick-up (OPU) team and skilled ET technician are needed. Therefore, the research project aims to evaluate the efficiency of the ultrasound-guided ovum-pick-up (OPU) technique for *in vitro* embryo production, transfer, and pregnancy rates, compare MOET and IVP efficiency, evaluate factors affecting pregnancy rates in dairy cattle, and provide expert training. First-year activities of this project included initiation workshop, fellow recruitment, OPU equipment purchase, training of research fellows, selection of donors and recipients through evaluating biochemical analysis of blood serum and feed and ultrasonographic monitoring of ovary and uterus. Two studies were performed to select donors and recipients of cows and heifers. The study evaluated the impact of total mixed ration (TMR) and lactation stage on the productivity, reproductive, and biochemical parameters of lactating cows. Results showed significant differences in crude fibre, crude protein, N-free extract, ADF, and NDF% among subgroups of TMR and lactation stages. The study also found that body weight, milk yield, first day of pick yield, duration of pick yield, triglycerides, ALT, glucose, and age of the first Artificial insemination had positive and negative correlations with these parameters. The study evaluated lactating cows' productive and reproductive parameters, focusing on correlations between total protein, BUN, and glucose levels. Results showed that early-stage lactating cows had higher average milk yield, while late-lactating cows had lower yields. Glucose levels had a strong negative correlation with calving to first heat, AI, milk yield, and pick yield. However, research activities are going on according to the work plan. The project expects to improve dairy cattle embryo transfer in Bangladesh by understanding trends and challenges in *in-vivo* and *in-vitro* embryo production, storage and transfer

CHAPTER II
Faculty of Agriculture

Allelopathic Effect of *Shorea Robusta* (Sal) Residues on Weed Growth and Yield Performance of *Boro* Rice

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Abstract
Allelopathyis considered an alternative, biological method for controlling weeds because it has no aftereffects on the ecosystem. The present experiment was conducted at the Agronomy Field Laboratory, BAU to study the allelopathic effect of *Shorea robusta* (Sal) residues on weed growth and yield performance of *boro* rice. The field experiment consisted of two rice cultivars, *viz*., BRRI dhan28and BRRI dhan29, and five residual treatments of Salleaves, such as no leaf residues, 1.0,2.0, 3.0, and4.0 tha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications.Nine weed species belonging to seven families infested the experimental plots. The minimum weed growth was found by the BRRI dhan29 when Sal leaf residues were applied at the rate of 2.0 t ha^{-1}, while the maximum was found by the BRRI dhan28 with no leaf residues combination. The grain yield as well as the yield-contributing characters of BRRI dhan29 were the highest between the studied cultivars. The maximum reduction in grain yield was obtained with no leaf residues treatment. The highest number of effective $tillershill^{-1}$, number of $grainspanicle^{-1}$, 1000-grain weight, and grain yield were observed when residues of Sal applied @2.00 t ha^{-1}. BRRI dhan29 produced the highest grain yield under 2.0 t ha^{-1}, followed by Sal leaf residues at 3.0 t ha^{-1}. The analysis of correlation demonstrated that grain yield was positively correlated with the number of grains $panicle^{-1}$ and total tillers $hill^{-1}$ but negatively correlated with weed dry weight at different stages. Results of the study indicate that Sal leaf residues have the potential to inhibit weed growth and have a significant effect on the yield of *boro* rice. Therefore, Sal leaf residues might be used as an alternative method for controlling weedin rice cultivation.

Assessment of Allelopathic Effect of *Albizia Lebbeck* Leaf Residues on Weed Growth and Yield Performance of Rice

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Abstract
The present experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to study the effects of the residues of *Albizia lebbeck* on the yieldperformance of *boro* rice. The field experiment consisted of two rice varieties *viz*., BRRI dhan28 and BRRI dhan29, and five residual treatments of *A. lebbeck* leaves such as 0, 1.0, 2.0, 0.3 and 4.0 t ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Five weeds belong to four families were identified in the field such as Shama, Panikachu,Sabuj nakful, Angta, Pani chaise. Among the weed species two were sedge, two were grasses and another one was broad leaf type morphology. Variety had significant effect on most of the yield and yield contributing characters except number of total tillers $hill^{-1}$, number of effective tillers $hill^{-1}$, number of non-effective tillers $hill^{-1}$ and harvest index. On the other hand, *A. lebbeck* residues had also significant effect on yield and yield contributing characters of rice yield except number of non-effective tillers $hill^{-1}$, panicle length, grains $panicle^{-1}$, number of sterile spikelets, and 1000-gain weight. The highest number of total tillers $hill^{-1}$, highest number of effective tillers $hill^{-1}$, higher 1000-grain weight, grain yield, straw yield and biological yield was obtained from BRRIdhan29 and residues applied @ 3.0 t ha^{-1}. The lowest grain yield and others yield contributing characters were found in control treatment due to lower number of effective tillers $hill^{-1}$ and higher number of sterile spikelet $panicle^{-1}$. From the above results it was found that the variety BRRI dhan29 and residues @ 3.0 t ha^{-1} produced superior effect. Therefore, *Albizia lebbeck*residues could be a potential source of biological weed management and yield enhancement tool for sustainable crop production.

Integrated Effect of Manures and Fertilizers with the Allelopathy of *Cyperus Difformis* and *Eleocharis Atropurpurea*to Estimate the Yield Performance of *T. Aman* Rice

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Abstract
We conducted present experiment at the Agronomy Field Laboratory, BAU, to investigate the suppression of weed growth through *Cyperus difformis andEleocharis atropurpurea* residues and to estimate the combined effect of manures and fertilizers in transplant *aman* rice. The experiment consisted of two cultivars i.e; Binadhan-13 and BRRI dhan34 and seven treatment such as Control, Residues 3 t ha^{-1} + Cowdung 5 t ha^{-1}, Residues 3 t ha^{-1} + Cowdung 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}), Residues 3 t ha^{-1} + Vermicompost 5 t ha^{-1}, Residues 3 t ha^{-1} + Vermicompost 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}), Residues 3 t ha^{-1} + Trichocompost 10 t ha^{-1}, Residues 3 t ha^{-1} + Trichocompost 5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Weed population and weed dry weight were significantly affected by treatment. Yield and yield contributing character like grains $panicle^{-1}$, grain yield, straw yield etc. were significantly affected by the interaction between variety and weed residues with manures and fertilizers. Binadhan-13 under T_3 treatment produced the highest grain yield, straw yield and harvest index and the lowest grain yield and straw yield were obtained from BRRI dhan34 under control. Therefore, *Cyperus difformis andEleocharis atropurpurea* residues combined with manures and fertilizers could be a potential source of eco-friendly weed management and yield enhancement tool for sustainable crop production.

Effects of Arbuscular Mycorrhizal Fungi on the Performance of Maize Under Rainfed Condition

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Abstract
Arbuscular mycorrhizal fungi (AMF) can create a symbiotic association with plant roots forming a hyphal network which enables the plant harvest soil moisture and nutrient from a larger rhizosphere. As a result,an AMF symbiotic plant suffers less stress than a non-symbiotic plant growing in the same stressful condition.AMF has been used in many crops in to cope with drought, salinity and heavy metal stress as well as to cut the fertilizer use in nutrient-deficit soils. An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural university to evaluate the inoculation potential of AMF with maize varieties, to judge the potential of AMF symbiosis on reducing soil moisture stress in maize, and to estimate the phosphorus use efficiency of maize as affected by AMF symbiosis in rainfed condition. The experiment was comprised of three factors, viz., irrigation (irrigated and non-irrigated), AMF inoculation (inoculation and non-inoculation) and levels of phosphorus (P) (no P, 50% recommended dose (RD) of P, and 100% RD of P). A split-plot design with three replications was followed with irrigation in the main plots and combination of AMF and P levels in the sub-plots. The inoculation potential of maize variety (Kohinoor) was confirmed through microscopic evaluation of dissected roots. The values of SPAD, and ROS and anti-oxidant parameters of maize leaves suggested that AMF inoculated reduced moisture stress in maize under non-irrigated condition. AMF inoculation increased grain yield of maize under rainfed condition and no or low P fertilizer treatments. It appeared that irrigated maize (3 times) performed better in terms of growth grain yield than AMF inoculated plants. Therefore, arbuscular mycorrhizal fungi can be used for maize cultivation in drought-prone area of Bangladesh.

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Yield Performance of Transplant *Aman* Rice Cultivars as Influenced by Allelopathy of *Paspalum commersonii* Extracts

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Abstract
A pot experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, to evaluate the yield performance of transplant *aman* rice cultivars as influenced by allelopathy of *Paspalumcommersonii*. The experimental treatments consisted of ten T. *aman* rice cultivars i.e., Binadhan-7, Binadhan-13, BR11, BRRI dhan32, BRRI dhan33, BRRI dhan34, BRRI dhan49, BRRI dhan52, Kalijira and Nizershail and three *P. commersonii* extract i.e., control, fresh plant extract and dry plant extract. The experiment was laid out in a complete block design (CRD) with three replications. Fourteen weed species belonging to six families infested the experimental pots. Weed population and weed dry weight were significantly affected by cultivar and plant extract treatment. The maximum weed growth was noticed with the cultivar BRRI dhan33 and the minimum were found in the cultivar Nizershail. The highest weed density and weed dry weight observed in control treatment and the lowest weed density and weed dry weight were noticed in fresh extract treatment. The grain yield as well as the important yield contributing characters produced by Nizershail was the highest among the studied varieties due to higher number of total tillers hill^{-1}, effective tillers hill^{-1} and grains panicle^{-1}. The highest reduction of grain yield was obtained in no crop extract treatment. Accordingly, the cultivar Nizershail produced a higher yield under fresh extract treatment. Results of this study indicate that *P. commersonii* extract showed potentiality to inhibit weed growth whereas fresh extract suppressed more weed growth and it has a significant effect on the yield of transplant *aman* rice. Therefore, the present study was useful in the screening of the most efficient cultivars, which could be strongly recommended to rice growers to improve crop yield and reduce the use of chemical herbicides.

Allelopathic Action of Fresh and Dry Plant Extracts of *spilanthesiabadicensis* (haludnakful) on Weed Growth and Yield Performance of *T. Aman*rice Cultivars

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Abstract
Exploration of weed plants with alleopathic properties is required in weed management as a possible alternative to synthetic herbicides. Therefore, a study was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, to evaluate the allelopathic action of fresh and dry weed plant extracts of *Spilanthesiabadicensis*on weed growth and yield performance of T. *aman*rice. The experiment consisted of fresh and dry aqueous plant extracts of *S. iabadicensis*andten T. *aman*rice cultivars (Binadhan-7, Binadhan-13, BR11, BRRI dhan34, BRRI dhan49, BRRI dhan51, BRRI dhan52, BRRI dhan71, BRRI dhan75 and BRRI dhan87).The experiment was laid out in a complete block design (CRD) with three replications.Three weed species belonging to three families infested the experimental pots. The weeds of T.*aman* experimental pots were shama (*Echinochloacrusgalli*),panikachu (*Monochoriavaginalis*) and panichaise (*Eleocharisatropurpurea*). Results showed that application of fresh and dry extracts reduced weed population and weed dry weight. However, the lowest weed density and weed dry weight were observed in fresh plant extracts compare to dry extracts.Among the cultivars, the highest weed density was found in BRRI dhan87 and the highest weed dry weight was found in BRRI dhan52. Yield and yield contributing characters were significantly affected by variety and extract treatment. The highest number of effective tillers hill^{-1}, number of grains panicle^{-1}, 1000-grain weight, grain and straw yields were observed in application of fresh extracts of *S. iabadicensis.*Results of this study indicate that *S. iabadicensis* extracts showed potentiality to inhibit weed growth and it has a significant effect on the yield of T. *aman*rice. Therefore, *S. iabadicensis* extracts might be used as an alternative way for weed management and sustainable crop production.

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Influence of Variety and Split Application of Potassium Fertilizer on Yield and Potassium Use Efficiency of *T. Aman* Rice

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Abstract
Potassium is known as quality nutrient, enhances crop yield and quality. Therefore, a field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, to explore the effect of variety and potassium management on yield and potassium use efficiency of rice. Three rice varieties (Bashiraj, BRRI dhan49 and BRRI hybrid dhan4) and six potassium (K) management [K_0 = 0 Kg K_2O ha^{-1} (Control), K_1 = 90 Kg K_2O ha^{-1} (All as basal), K_2 = 45 Kg K_2O ha^{-1} (Basal) + 45 Kg K_2O ha^{-1} (at 30 DAT), K_3 = 90 Kg K_2O ha^{-1} (at 30 DAT), K_4 = 45 Kg K_2O ha^{-1} (at 30 DAT) + 45 Kg K_2O ha^{-1} (at 60 DAT) and K_5 = 30 Kg K_2O ha^{-1} (Basal) + 30 Kg K_2O ha^{-1} (at 30 DAT) + 30 Kg K_2O ha^{-1} (at 60 DAT)] were used as treatments. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Results revealed that BRRI hybrid dhan4 produced the highest number of grains $panicle^{-1}$, 1000-grain weight (g), grain yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%).The results of potassium management revealed that yield and yield components of rice except panicle length and number of sterile spikelets $panicle^{-1}$ were increased with the split application of potassium and decreased with no potassium (K) application. BRRI hybrid dhan4 variety with application of potassium in three equal split practices [30 Kg K_2O ha^{-1} (Basal) + 30 Kg K_2O ha^{-1} (at 30 DAT) + 30 Kg K_2O ha^{-1} (at 60 DAT)] gave the highest yield (6.37 t ha^{-1}) than any other varieties and treatments. Therefore, it may be concluded that, the application of potassium in three equal splits may be followed to achieve higher yield in rice cultivation.

Development of Agronomic Package for Some Hilly Black Rice Cultivars for Plain Land Ecosystem

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Abstract
Black rice is a type of the rice species *Oryza sativa* L. which is glutinous, packed with high level of nutrients and mainly cultivated in Asia. In Bangladesh, the black rice is being cultivating in the remote hilly areas including Bandarban district as shifting cultivation without any agronomic management practices and hence giving very low yield. However, the overall cultivation procedure of this black rice under plain land condition is still unknown in Bangladesh. Therefore, this study intends to develop an agronomic package for few hilly black rice cultivars in plain land environment of Bangladesh.Out of a series of experiments, the current experiment consisted of three irrigation methods, including Alternate wetting and drying method, Farmer's practice method and Continuous standing water throughout the season with two black rice cultivars.The experiment was set up using a split plot design, with irrigation methods placed in the main plot and rice varieties placed in the sub-plots with three replications. Irrigation method had a significant impact on the yield of black rice in the plain land ecosystem and other yield-contributing traits. The Alternate wetting and drying methodproduced the highest plant height (115.93 cm), number of total tillers $hill^{-1}$ (11.67), number of effective tillers $hill^{-1}$(10.33), panicle length (28.77 cm), number of grains $panicle^{-1}$ (96.91), weight of 1000 grain (27.91), grain yield (5.30 t ha^{-1}), straw yield (7.54 t ha^{-1}) and biological yield (12.84 t ha^{-1}). As opposed to this, highest number of sterile spikelets $panicle^{-1}$ (24.42) was found in Farmer's practice method. Production of different varieties showed significant influence on the yield contributing characters and yield of black rice in plain land ecosystem. The maximum plant height (121.77 cm), number of total tillers $hill^{-1}$ (11.67), number of effective tillers $hill^{-1}$ (10.44), panicle length (28.78 cm), grains $panicle^{-1}$ (97.78), 1000-grain weight (29.15), grain yield (5.77 t ha^{-1}), straw yield (7.66 t ha^{-1}), biological yield (13.43 t ha^{-1}) and harvest index (42.45%) were all generated by the Ketan hitam. Considering the interaction, highest yield of grains (5.86 t ha^{-1}), yield of straw (7.73 t ha^{-1}), yield of biological yield (13.60 t ha^{-1}) was found from the Alternate wetting and drying methodwith Ketan hitamwhich might be recommended for obtaining higher yield of black rice in plain land ecosystem.

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Efficacy and Economics of Neem Oil Coated Urea for Rice Cultivation in Bangladesh

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Abstract

In Bangladesh, farmers use lots of urea fertilizer in rice cultivation and almost 70% of that applied urea is lost in various ways. The neem oil coated urea could be a way of minimizing this loss and can save a huge amount of foreign currency each year. Keeping these view in mind, two experiments were set to find out the feasibility of using neem coated urea fertilizer in aman and boro season of rice cultivation. In aman season three varieties (BRRI hybrid dhan4, BRRI dhan87 and Binadhan-17) and five levels of neem oil (0, 3, 5, 7 and 10ml neem oil/kg urea) were used. In boro season three varieties namely BRRI dhan28, BRRI dhan89 and Binadhan-24 with same levels of neem oil as in aman season were used as experimental treatments. There were 45 plots in each experiment. The split plot design with three replications was used in the experiments where neem oil concentration was allocated in main plots and varieties were distributed in subplots. The unit plots wereuniformly fertilized with, urea, triple super phosphate, muriate of potash and gypsum according to the BRRI and BINA recommended dose of aman and boro rice variety. In aman season it has been found that highest yield was produced (6.33 t/ha) when 7 ml neem oil per kg urea was used and lowest was found without neem oil treated plot. In case of straw yield highest was observed when 5 ml neem oil per kg urea was applied. However, highest grain yield (5.98t/ha) and straw yield (8.80 t/ha) was produced by BRRI dhan87. Considering the interaction, highest grain yield (7.8 t/ha) was found when 3 ml neem oil per kg urea was used with the variety BRRI dhan87.In boro season, numerically the highest number of effective tillers per hill was observed when 7 ml neem oil was used per kg urea. Maximum grain yield (7.61 t/ha) was found in 5 ml neem oil per kg urea. Maximum number of effective tillers per hill (12.27) and number of grains per panicle (118.6) was observed in BRRI dhan28. In case of grain yield significantly highest was observed (6.49 t/ha) in Binadhan-24 which was statistically similar to that of BRRI dhan89 (6.23 t/ha). Highest straw yield was observed in BRRI dhan28 (7.75 t/ha) which was statistically similar to that of BRRI dhan89 (7.72 t/ha). Considering interaction effect of neem oil concentration and variety, it has been found that highest grain yield (7.1 t/ha) was found when 7 ml neem oil per kg urea was used with the variety Binadhan-24.

Assessment of Aqua-Crop Model for Irrigation Simulation and Grain Yield of Dry Direct Seeded Rice

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Abstract

Water demand growth in urban, industrial, recreational and environmental purposes creates more competition for the limited resources. The AquaCrop model can be used to simulate rice yield in response to water. With the vision of using AquaCrop for local scale decision making for field level water management, a study was undertaken at the Agronomy Field Laboratory, BAU, Mymensingh during February to June of 2022 and 2023 to examine the capabilities of the model to describe rice biomass production and grain yield in different irrigation scenarios.The experiment comprised of four*boro* rice varieties viz., BRRI dhan28, BRRI dhan29, BRRI dhan89 and BRRI dhan100 andthree level of irrigation viz., no irrigation, irrigation atalways remain field capacity (FC) moisture (0.33 bar) andirrigation at 25% of water disappearance from FC. The experiment was laid out in a split plot design assigning irrigation in main plot and variety in subplot with three replications. The model was calibrated using the measured dataduring growing season.The highest growth duration (125 days) was obtained from BRRI dhan29 followed by BRRI dhan89.The highest average green canopy coverage (98 %), dry above ground biomass (5.8 t ha^{-}

^{1}), soil water content (380 mm) was observed at 90 days after sowing. The total water was applied 0 mm, 100 mm and 120 mm for no irrigation, irrigation atalways remain field capacity (FC) moisture (0.33 bar) andirrigation at 25% of water disappearance from FC respectively. The application of these minimum water in *boro* season is a tremendous achievement of this study. The maximum grain yield 5.49 t ha^{-1} was found in BRRI dhan89 and irrigation at 25% of water disappearance from FC produced highest grain yield (5.63 t ha^{-1}). This model needs to be validated in other areas of Bangladesh before final conclusion.

Evaluation of *Boro* Rice Varieties by Exploiting and Adjusting Existing Technologies

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Abstract
Management practices are very crucial for successful crop production. To evaluate cultural practices,a field experiment was carried out during the period from November 2022 to May 2023 at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh with*boro* rice varieties. The experiment comprised of five*boro* rice varieties viz., BRRI dhan28 (V_1), BRRI dhan29 (V_2), BRRI dhan81 (V_3), BRRI dhan89(V_4) and Binadhan-10 (V_5)and two treatments on a management practice viz., Farmers' practices (FP) and Improved practices (IP). The two factorial experiments were laid out in a randomized complete block design (RCBD) with three replications. The number of total tillers, effective tillers, number of grains panicle^{-1}, biological yield, and harvest index varied significantly due to variety. The highest biological yield (13.34 t ha^{-1}) was found in BRRI dhan89 and the lowest 11.35 t ha^{-1}was observed in BRRI dhan28. In terms of management practices, the highest grain yield (6.29 t ha^{-1}) was obtained due toIP and the lowest grain yield (5.69 t ha^{-1}) was recorded in FP. The interactive effect of variety and management exerted that the performance of the combination of BRRI dhan89and IP was the highest (6.58 t ha^{-1}) for grain yield and the lowest performance (5.03 t ha^{-1}) in grain yield was found in BRRI dhan28 with FP. Thus, the variety BRRI dhan89 with IP was superior for attaining the highest yield and can be recommended for large scale cultivation. It is necessary to verify the study in different regions before final recommendation.

Cropping Pattern Based Micronutrient Determination for Mustard- *boro- T. Aman* Crop Sequence Under Old Brahmaputra Floodplain Region of Bangladesh

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Abstract
Strengthening of agricultural land usage coupled with farming of modern varieties has occasioned in weakening of soil fertility, with emergence of macro- and micro-nutrient deficiency of crops. Considering this point, a study was undertaken to assess the requirement of selected micronutrients for crops and cropping patterns. Experiments were conducted at Agronomy Field Laboratory, BAU, Mymensingh in 2022-2023. In experiment 1, the field trial was done with six micronutrients (B, Zn, Cu, Mn, Fe and Mo) designed in an additive manner. These elements were executed to the first crop and their remaining effects were checked on the next two crops over the patterns: Mustard-*Boro-T. aman*. The rates of micronutrient application were 3 kg Zn, 2 kg B, 2 kg Cu, 3 kg Mn, 5 kg Fe and 1 kg Moha^{-1}. The results exposed that across the experimental sites, the crops were fairly reactive to the added Zn and B. Positive effect of Cu was also noted in some cases. In the following crop (expt. 2), two micronutrients, Zn and B were taken into the similar cropping pattern and designed in a way to fix whether 1st crop, 2nd crop or 3rd crop application is necessary to achieve satisfactory crop yield. The rates of Zn application were 0, 2, 4 & 6 kg ha^{-1}, and the rates for B were 0, 1.5 and 3 kg ha^{-1}. The results showed that Zn application at 4 kg ha^{-1} attached with B application at 1.5 kg ha^{-1} to the first crop can meet their requirement for the subsequent two crops in a pattern. The current study suggested that cropping pattern-based field trials with Zn, B and Cu need to be completed in the high cropping intensity areas in order to control micronutrient requirement of crops.

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Effect of Integrated Nutrient Management on the Yield Performance of *T. Aman* Rice

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Abstract
An experiment was conducted at the Agronomy Field Laboratory, BAU, Mymensingh from September 2022 to June 2023 to measure the effects of the integrated nutrient management on the yield performance of T. *aman* rice. The experiment consisted ten treatments such as control (T_1, no application of manure and inorganic fertilizers), recommended dose of NPKS (T_2), Tricho compost @ 5.0 tha^{-1} (T_3), Tricho-compost @ 2.5 tha^{-1} + 50% less of recommended doses of NPKS (T_4), Cowdung @ 5 tha^{-1} (T_5), Cowdung @ 2.5 tha^{-1}+ 50% less of recommended doses of NPKS (T_6), Vermicompost @ 5 tha^{-1} (T_7), Vermicompost @ 2.5 tha^{-1} + 50% less of recommended doses of NPKS (T_8), Bone powder @ 5 tha^{-1} (T_9), Bone powder @ 2.5 tha^{-1} + 50% less of recommended doses of NPKS (T_{10}). BRRI dhan71 was used as test crop. The experiment was laid out in Randomized Complete Black Design (RCBD) with three replications. Integrated nutrient management had significant effects on rice yield and yield contributing characteristics except panicle length, sterile spikelets per panicle, 1000-grain weight and harvest index. Highest plant height (105.67 cm), higher number of total tillers $hill^{-1}$ (11.41), higher number of effective tillers $hill^{-1}$ (9.55), longest panicle (24.51), maximum number of grains $panicle^{-1}$ (118.36), higher 1000-grain weight (25.06 g), maximum grain yield (6.48 tha^{-1}), maximum straw yield (7.55 tha^{-1}) higher biological yield (14.03 tha^{-1}) and higher harvest index (46.64%) was obtained at applied of tricho-compost @ 2.5 tha^{-1} + 50% less of recommended doses of NPKS (T_4). The lowest grain yield (4.07 tha^{-1}) was recorded at control treatment. Therefore, it was revealed that tricho-compost @ 2.5 tha^{-1} + 50% less of recommended doses of NPKS could be applied for BRRI dhan71 rice cultivar for obtaining maximum yield in T. *aman* season.

Induction of Heat and Drought Tolerance in Wheat Through Seed Priming

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Abstract
High temperature stress during reproductive stage as the consequence of short winter spell and delayed planting along with moisture stress result in significant yield reduction of wheat. Seed priming has been reported to be effective in combating abiotic stresses in different crops. Therefore, a study was conducted to explore the potentiality of seed priming technique in combating heat and moisture stresses in wheat. Eight priming agents (H_2O, NaCl, Mannitol, $CaCl_2$, KCl, PEG, KNO_3, NaOCl) at different concentrations along with control were tried for increasing seed germination and seedling vigor (laboratory condition) and combating high temperature or moisture stresses (field condition) of wheat (BARI Gom-33) at the Agronomy Department, BAU during rabi seasons of 2021-22 and 2022-23. Laboratory experiment was conducted following CRD method with 4 replications while field experimentswere conducted following RCBD method with 3 replications. In laboratory experiment, seed priming increased germination rate by up to 5%, mean germination time by 1.5 days and seedling vigor index up to 7 unit, and seedling dry matter up to 4 mg/seedling. $CaCl_2$, KCl, KNO_3, Mannitol and PEG appeared as promising priming agents.Field experiments confirmed the positive influence of seed priming in increasing wheat yield under high temperature stress (late sown condition) or moisture stress. Wheat yield was reduced with the delay of sowing after November (due to high temperature stress) and also under moisture stress. But seed priming helped mitigate both the stresses to some extent. Seed priming with 20000 ppm $CaCl_2$ or KCl increased wheat yield by up to 7% under high temperature stress and 9% under moisture stress. Therefore, it is recommended to sow wheat by November following pre sowing seed priming and incase of delay sowing, seed priming (with 20000 ppm $CaCl_2$ or KCl) is a must to mitigate the temperature ormoisture stress to some extent.

Integration of Co-composted Faecal Sludge with Chemical Fertilizers for Sustainable Rice Production

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Abstract
A study was conducted to judge the efficacy of co-composted fecal sludge (CCFS) in increasing productivity and profitability of T. *Aman* rice. Treatments included two T. *Aman* rice varieties namely, BRRI dhan49 and Dhanigold; and 10 chemical fertilizer + CCFScombinations such as, recommended chemicalfertilizer (RDF), CCFS @ 5 t ha^{-1}, RDF + CCFS @ 2 t ha^{-1},RDF + CCFS@ 1.5 t ha^{-1},RDF + CCFS@ 1 t ha^{-1},RDF + CCFS @ 0.5 t ha^{-1}, 75% RDF + CCFS@ 2 t ha^{-1}, 75% RDF + CCFS@ 1.5 t ha^{-1}, 75% RDF + CCFS @ 1 t ha^{-1} and 75% RDF + CCFS@ 0.5 t ha^{-1}. A clear advantage of integrating CCFS with chemical fertilizers in increasing rice yield (>7%) was evident. The highest rice yield was recorded when CCFS @ 2 t ha^{-1} was integrated with RDF. But application of only CCFS @ 5 t ha^{-1} reduced grain yield upto 47%. The highest benefit: cost ratio for BRRI dhan49 and Dhanigold (1.66 and 1.61, respectively) were calculated from only RDFapplication closely followed by application of RDF + CCFS @ 2 t ha^{-1}. Application of only CFS @ 5 t ha^{-1} resulted in negative net return and <1 benefit: cost ratio due to very poor yield and high cost for CCFS. Encouraging findings confirm that CCFS can be integrated with chemical fertilizers to increase rice productivity. Application of RDF + CCFS @ 2 t ha^{-1} appeared as the best for productivity, but application of only RDF was found more economic than integration. Application of only CCFS was found neither productive nor economic. To conclude, co-compostcan be used to supplement chemical fertilizersfor rice cultivation, and thus will contribute to green agriculture by improving soil health and minimizing environmental pollution.

Effect of Sulphur and Zinc Nutrition on Growth and Yield of Short Duration Mustard

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Abstract
The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the *Rabi*season from November 2022 to February 2023 to evaluate the response of sulphur and zinc nutrition to the growth and seed yield of short duration mustard (BARI Sarisha-18). The experiment was laid out in randomized complete block design with three replications consisting of three levels of sulphur (0, 10 and 20 kg ha^{-1}) and zinc (0, 1 and 2 kg ha^{-1}). It was observed that 20 kg sulphur ha^{-1} gave significantly highest growth, seed yield and harvest index owing to the highest number of branches plant^{-1}, siliqua plant^{-1}, seeds siliqua^{-1} and 1000-seed weight. Conversely, 0 kg sulphur ha^{-1} provided the lowest seed yield of mustard. Again, the highest number of branches plant^{-1}, siliqua plant^{-1} and seeds siliqua^{-1} was found at 2 kg zinc ha^{-1} which resulted in the highest seed yieldand harvest index. The lowest performance of the yield components and yield was observed at 0 kg zinc ha^{-1}. Interaction effect between 20 kg sulphur ha^{-1} and 2 kg zinc ha^{-1} produced the highest seed yield and stover yield because of the highest number of branches plant^{-1} and seeds siliqua^{-1} and the worst yield performance was observed at the control treatment. Therefore, the application of sulphur and zinc at the rate of 20 kg ha^{-1} and 2 kg ha^{-1}, respectively could be applied for BARI sarisha-18 for higher seed yield.

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Root Architecture and Yield of Rice as Influenced by Agronomic Management

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Abstract

Irrigation and fertilizer are two essential factors affecting rice root traits and yield. In thisrespect, a pot experiment was performed at the boro (dry season irrigated) season of 2021–2022 in theDepartment of Agronomy of Bangladesh Agricultural University, Mymensingh, Bangladesh. Thevariety Binadhan-10 was planted at two irrigation conditions, i.e., saturation (S) and continuousflooding (CF); two potassium (K) doses, e.g., 65 kg ha^{-1} (K_{65}) and 98 kg ha^{-1} (K_{98}); and two nitrogen (N) doses, i.e., 140 kg ha^{-1} (N_{140}) and 210 kg ha^{-1} (N_{210}). The experiment was laid in a split plotdesign with eight treatments and replicated thrice. The findings confirmed the significant variation inirrigation, K and N and the effects on root number (RN), root length (RL), root volume (RV), leaf areaindex (LAI), total dry matter (TDM), yield attributes and yield. Considering the interaction amongirrigation, K and N, the S conditions with K65 and N140 showed best performance in relation to rootparameters. At 80 DAT, the highest RN (373.00), RL (1700.00 cm), RV (8.90 cm3 $hill^{-1}$), LAI (4.94) and TDM (25.83 g $plant^{-1}$) was obtained from this combination. Grain yield (GY) and root traits, except root porosity, showed a significant positive association. Grain yield (GY) was the highest (27.12 g pot^{-1}) under S conditions with K_{65} and N_{140}. Therefore, the variety Binadhan-10 can besuccessfully cultivated with K_{65} and N_{140} under S conditions.

Designing and Developing Climate Change Resilient Cropping Systems for the Haor Area of Bangladesh

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Abstract

Intensification and diversification of existing rice-based mono-cropping system of *haor* area can play avital role in achieving food security and improving climate resiliency. With a view to formulate climate smart cropping systems for the vast fertile *haor* area, four studies were conducted in the four *haor* regions (Netrakona, Sunamganj, Kishoreganj and Moulovibazar) of Bangladesh during 2022 to 2023. The study was aimed to create an inventory of existing climatic and cropping systems of *haor* area. The initial methods utilized to evaluate the scenarios of the current cropping systems in the research area were focus groups and in-depth interviews with farmers utilizing questionnaires. The study utilized a sample of 250 farmers (for each location) using structured and semi-structured questionnaires, as well as secondary data sources from GOs and NGOs with a focus on socio-economic status, demographic profile, along with cropping systems. The average cultivable land area was 18%, 26 % and 17 %for single, double and triple cropping respectively. Participants' perceptions about climate change ranged from 8 % to 48 % in several categories, highest fortheir conceptabout climate change was flash flood. About 36% farmers are interested to cultivate oil seed crop and 24% are attentive to cultivate pulse crop before boro rice cultivation. The inclusion of short-duration crops (mustard andblack gram) in the study areas prior to the boro rice-based mono cropping system and fertilizer management in *boro* riceis now evaluating considering agronomic and modeling (APSIM) approaches.Therefore, the results of this study will demonstrate the potentiality of inclusion of short duration crop before *boro* rice and fertilizer management in *boro* rice based on crop performance and future climate scenario simulated by APSIM model.

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Enhancing the Efficiency of Herbicides by Combining Allelopathic Potential Aqueous Extract of Sorghum and Mustard for Weed Management in Upland Crops

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Abstract
Reducing herbicide use is essential for sustainable agriculture due to rising costs, environmental concerns, and herbicide resistance. In this phenomenon two experiments were conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the effect of aqueous extract of mustard and sorghum crop residues on weed management and crop performance of wheat. These experiments consisted of three varieties of wheat viz., BARI Gom-32 (V_1), BARI Gom-33 (V_2), BWMRI Gom-1 (V_3) and six different levels of treatments such as no weeding (T_1), recommended dose of herbicide (RDH) (T_2) (Panida 33EC @2000 ml ha^{-1}, at 5 DAS as pre- emergence), 90% RDH + aqueous extract of mustard crop residues 1:20 (w/v) (T_3), 80% RDH + aqueous extract of mustard crop residues 1:20(w/v) (T_4), 70% RDH + aqueous extract of mustard crop residues 1:20(w/v) (T_5), 60% RDH + aqueous extract of mustard crop residues 1:20 (w/v) (T_6) and in the second experiment the varieties and treatments were the same. These experiments were conducted in a randomized complete block design with three replications. Weed population, dry weight, and percent inhibition were significantly affected by aqueous extracts of sorghum and mustard residues and wheat varieties. BWMRI Gom-1 showed maximum weed growth, while BARI GOM-32 exhibited the minimum and highest grain yields and no weeding resulted in the highest grain yield loss. The maximum grain yield (5.10 t ha^{-1}) was overserved in the combination of BARI Gom-32 and RDH is donefollowed by the application of aqueousextract of mustard and sorghum crop residues (1:20) cultivar with all treatments produced the highestgrain and straw yield among the treatment combination. The results of this study indicate that differentamount of aqueous extract of mustard and sorghum crop residues showed potential activity to suppressweed growth and yield of wheat.

Enhancing Weed Control Efficacy by Integrating the Reduced Rate of Herbicide with Extracts of Boiled Aqueous Crop Residues in *T. Aus* Rice

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Abstract
Boiled extract of allelopathic crops have the potential to control weeds successfully, particularly when integrated with reduced herbicide doses.Two field experiments were conducted to evaluate the effect of allelopathic boiled extract of sorghum and mustard crop residues combined with reduced doses of herbicide (Granite 240 SC) inT.*aus*rice. In first experiment, treatments consist of two factors viz. variety (3)-BRRI dhan48, BRRI dhan98, Binadhan-21and application of boiled extract with reduced rate of herbicide (5)-Control, Recommended doses of herbicide at post emergence, 80% recommended doses of herbicide at post emergence + sorghum crop extracts, 70% recommended doses of herbicide at post emergence + sorghum crop extracts,60% recommended doses of herbicide at post emergence + sorghum crop extracts.Second experiment also consists of two factors e.g. variety (3)-the same variety used in the experiment 1 and application of boiled extract with reduced rate of herbicide (5)- same as the experiment 1 with the extract of mustard.It was noticed that herb weed species were more susceptible to crop residues than grass weed species.In this respect, the highest growth inhibitions (79.80%) were observed in controlling Panilong(*Ludwigiaoctovalvis)* by the treatment of 80% recommended doses of herbicide at post emergence + sorghum residues extracts.Among the rice variety, BRRI dhan98 showed superior performance in respect of yield contributing characters and yield. In case of reduced rate of herbicide and boiled extract application, boiled extract of sorghum and mustard with reduced rate of herbicide (80% of recommended) as post emergence was the best for T.*aus*rice cultivation. From the findings of our study, it can be concluded that the studied crop residues extract and reduced rate of herbicide showed positive effect on weed growth, yield contributing characters and yield of T.*aus* rice.

Agronomic Biofortification of Zinc in Nizershail Rice Grown Both in Transplant *Aman* and *Boro* Seasons Under Changing Climate

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Abstract
Proper nitrogen (N) management is vital for gaining potential yield benefits of a variety. Adjusting transplanting time enables the plant taking benefit from natural conditions favorable for its growth. In light of these, an investigation was carried out in the *Boro* season at the Agronomy Field Laboratory, Bangladesh Agricultural University from November 2022 to April 2023 to investigate the impact of various transplanting dates and N levels on the yield of Nizershail rice. The study involved four dates of transplanting viz. 16 December, 31 December, 15 January, 30 January and four nitrogen (N) levels viz. 0, 50, 100 and 150% of the recommended dose (RD) of N from urea where the recommended dose was 90 kg urea per ha. The trial was replicated thrice using Randomized Complete Block Design (RCBD). Results showed that the tallest plant, the uppermost grains/panicle and 1000 grains weight were detected in 16 December transplanting and the maximum grain yield was observed in 31 December transplanting. For N, total tillers and effective tillers/hill, grains/panicle, the highest grain and straw yields were found from 100% RD of N and the highest panicle length and sterile spikelets/panicle were found from 150% RD of N. In interactions, the maximum effective tillers/ hill and straw yield were observed from 100% RD of N in combination with 15 January transplanting. The maximum 1000 grains weight and the grain yield were obtained from 100% RD of N in combination with 16 December transplanting. From the result, it may be assumed that to get the maximum yield of Nizershail rice in *Boro* season could be transplanted between 16 December to 15 January with 100% RD of N from urea.

Development of t. *Aman* Rice- Mustard- *Patshak*- t. *Aus* Rice Based Cropping Systems in Existing *T. Aman* Rice-Fallow- *boro* Rice Cropping Systems through Agronomic Management

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Abstract
Four experiments were conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to study the feasibility of growing four crops in existing T. *aman* rice- Fallow- *Boro* rice cropping systems through agronomic management. In *aman* season, BRRI dhan66 with application of USG produced the highest grain yield which was statistically similar with BRRI dhan66 and 2.5 t ha^{-1} poultry manure + 50% of RD of nitrogen from prilled urea (PU) and BRRI dhan66 with 100% recommended dose PU (150 kg ha^{-1}). In *rabi* season, Binasarisha-4 with 125% of the recommended dose of nitrogen fertilizer produced the highest seed yield of mustard which was statistically similar with Binasarisha-9 with 125% of RD recommended dose of nitrogen fertilizer. Therefore, the mustard yield could be maximized by application of 125% of recommended dose of nitrogen fertilizer using Binasarisha-4. The highest *Patshak* yield was obtained from BJRI Patshak-3 with 100% of RD of urea(46 kg N ha^{-1}). In T. *aus* rice, application of USG with Application of early post-emergence herbicide (AEPH) followed by one hand weeing at 30 DAT produced the highest grain yield which was followed by application of 2.5 t ha^{-1} poultry manure + 50% of RD of nitrogen fertilizer from PU with AEPH followed by one hand weeing at 30 DAT. In this research, T. *aman* rice was transplanted on 23 July and T. *aus* rice was harvested on 7 July that means four crops can be accommodated in a year in the same field. Finally, it can be recommended that four crops like T. *aman* rice- Mustard- *Patshak*- T. *aus* rice could be successfully grown in existing rice-based cropping systems by choosing short duration *aman* rice and short duration mustard cultivars. By adopting the technology of transformation of four crops in the existing T. *aman* rice -Fallow- *boro* rice-based cropping systems through agronomic management farmers' income will be maximized.

Maximizing Farm Productivity through Agronomic Management to Attain Food Security

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Abstract
In order to produce more food within a limited area, it is necessary to increase cropping intensity producing three or more crops in the same piece of land round the year.The objective of the study was toobserve the feasibility of growing T. *aman* rice- Mustard- *Patshak* - T. *aus* rice in existing T. *aman* rice- Fallow- *Boro* rice based cropping pattern. To fulfill the objective four crops were grown viz., short duration T. *aman* rice- Short duration mustard, Patshak and T. *aus* rice were grown in the same filed in a year.The highest grain yield (5.21 t ha^{-1}) was produced from the interaction of Binadhan-7 × application of duration mustard varieties, USG. Binasarisha-4 fertilized with 100% of RD of N produced the highest seed yield (1.44 t ha^{-1}). Biomass yieldwas varied significantly due to the interaction effect of variety and nitrogen management. It was found that Binapatshak-1 fertilized with 100% of RD of N produced the highest yield (0.87 t ha^{-1}). Gross income from different varieties of *Patshak* was significantly varied due to varietal effect. Table 7 indicates that Binapatshak-1 produced the highest gross income (15450 Tk. ha^{-1}) than the other varieties.The highest grain yield (5.08 t ha^{-1}) was produced from the interaction of V_2N_2 (BRRI hybrid dhan7 × application of 2.5 t ha^{-1} poultry manure + 75% of recommended dose of prilled urea) which was statistically similar with V_2N_1 (BRRI hybrid dhan7 × 100% of recommended dose of prilled urea) (4.69 t ha^{-1}) and V_2N_3 (BRRI hybrid dhan7 × application of USG) (4.97 t ha^{-1}). Therefore, farmers can maximize their crop production as well as economic return by producing four crops in a year instead of two crops.

Effect of Nitrogenous Fertilizer Management on the Growth of Weed and Yield of Rice

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Abstract
Nitrogen is the primary nutrient element and it has a positive role on rice grain yield. Again, a high level of N supply may favor weeds over crop plants. To address this issue an experiment was conducted from June through October 2022 to find out the effect of integrated nitrogen management and weeding practices on weed growth and yield of T. *aman* rice (BRRI dhan71). The experiment consisted of five nitrogen levels*viz*., control (no N), 100% N from prilled urea, 100% N from poultry manure (PM), 50% N fromprilled urea + 50% N from PM and application of USG and five weeding practices *viz*., unweeded control, weed-free condition, pre-emergence herbicide and one hand weeding at 35 DAT, early post-emergence herbicide and one hand weeding at 35 DAT, pre-emergence herbicide followed by early post-emergence herbicide.The highest weed density and dry weight were observed in the application of 100% N from prilled urea with no weeding treatment, whereas the lowest weed density and dry weight were recorded in no N with a weed-free condition which was both labour and cost-intensive.The application of USG with pre-emergence herbicide followed by the early post-emergence herbicide exhibited lower weed density and dry weight cost-effectively. Numerically the highest grain (6.09 t ha^{-1}) and straw yield (6.50 t ha^{-1}) were recorded from the application of 50% N from urea + 50% N from PM with pre-emergence herbicide followed by early post-emergence herbicide which was very close to application of USG with pre-emergence herbicide followed by early post-emergence herbicide(grain yield 5.87 t ha^{-1} and straw yield 6.33 t ha^{-1}) with higher weed interference than the application of USG with pre-emergence herbicide followed by early post-emergence herbicide. Therefore, USG with pre-emergence herbicide followed by early post-emergence herbicide can be recommended for controlling weeds effectively as well as maximizing the grain yield of T. *aman* rice.

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Soil Carbon Sequestration by Conventional and Conservational Paddy Management

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Abstract
Tillage is needed for different agricultural processes. However, as a consequence, soil physical and chemical properties are also altered, ultimately leading to good or poor crop performance. Appropriate tillage practices, such as conservation tillage (CST), aim to avoid soil degradation without compromising crop yields and while maintaining or improving soil organic carbon (OC) stocks. Bangladesh has huge potential to contribute in global climate change mitigation through carbon (C) sequestration in paddy soils via CST managements. This study intended to (i) quantify the OC sequestration in paddy soils under conventional tillage (CVT) and CST management systems in selected weathered terrace soils of Bangladesh, and (ii) to assess the economic feasibility of CST management for paddy cultivation. Three common rice based cropping patterns, namely fallow-fallow-*boro*, fallow-*aman*-*boro*, and fallow-*aman*-mustard-*boro*, were chosen under conventional and conservation management approaches. Bulk soils were separated into two fractions in order to separate the labile organic matter (OC: >53 μm) and stable OC (mineral related OM: <53 μm), and then the OC and nitrogen content were measured. The potential ability of CST to store OC in soils is demonstrated by the overall higher OC in bulk soils, and stable fractions under CST management than labile fractions in all cases. The degree of disturbance of the agricultural land may be connected to the significantly increased OC in both soil fractions observed in fallow-fallow-*boro* when comparing cropping patterns. In terms of economics, CST produced more crop and incurred fewer costs associated with tillage than CVT, resulting in a higher income.

Efficacy of Organic Amendments in Enhancing Carbon Sequestration, Improving Soil Health and Crop Yield: In Relation to Amendments' Chemical Quality and Decomposition Rate

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Abstract
Loss of soil organic matter (SOM)/ soil organic carbon (SOC) and soil fertility has become a serious concern in Bangladesh and has turn out to be a crucial issue for feeding an increased population and also reducing greenhouse gas emissions. Depletion of SOMof this country's soils believed to be the result of increasing cropping intensity, higher rates of decomposition of organic matter under the prevailing hot and humid climate, use of lesser quantities of organic amendments, imbalanced fertilization etc. Most of our farmers are still very reluctant about adding organic amendments in their fields and in most cases, cultivation totally depends on high dose of chemical fertilizers. And in very few cases where the farmers use organic amendments, they just apply anything available without considering selecting the proper type or rate of amendments based on their targeted crop or soil type or management practices. Moreover, there is still basic knowledge gap in our country in the area of how the decomposition rate, nutrient release pattern of organic amendments can vary with amendments' own quantity and quality, as well as with climatic, edaphic and crop/land management factors. Thus, this project is aimed to get a better in depth understanding of the chemical properties of the locally available organic amendments and their efficacy in increasing/maintaining SOC stocks, soil health, crop growth and yield, and also deepen the knowledge in the process-how the performances of amendments can be improved with surrounding factors such as soil, temperature and land managements. Until now, selected floodplain and terrace soils from paddy fields, andorganic manures (cowdung, poultry manure, vermicompost) were collected,and an incubation experiment is undergoing to assess the nutrient release patterns of selected organic manures under two moisture (continuous waterlogging and field capacity)conditions.

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Optimizing Sowing Time of Selected *Boro* and *Aus* Rice Varieties Under Dry Direct Seeded System

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Abstract
Dry direct seeding is awater and labour saving rice production technology. This technology offers an opportunity of growing long duration rabi crops by delaying sowing time of boro rice in T. aman rice – Rabi crop – Boro/aus rice pattern. An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to find out the effect of sowing date on growth and yield of boro and aus rice grown under dry direct seeded system. The experiment comprised six rice varieties viz. Binadhan-14, Binadhan-19, BRRIdhan28, BRRIdhan48, BRRIdhan89 and BRRIdhan92; and four sowing dates viz. 25 January, 9 February, 26 February and 9 March, 2022 in a split plot design with three replications. Data on crop phenology, yield contributing characters and yield were collected and compiled. Data analysis was done with a computer package programmeSTATISTIX 10 and mean comparison was done with LSD-test. Among the rice varieties BRRI dhan92 gave the highest yield (7.33 t ha^{-1}) for sowing on 9 February 2022 and the next highest yield was found with BRRIdhan48 (7.14t ha^{-1}) sown on the same date. For sowing on 26 February 2022, the highest yield was noted with BRRIdhan89 sown on 26 February. The study concludes that boro rice varieties BRRIdhan92 and BRRIdhan89can be sown in late boro season for obtaining highest grain yield which in turn help growing any rabi crop in between aman rice and boro or aus rice under T. aman rice – rabi crops – DDS boro/aus rice patterns.

Development of Cultivation Technology of Nutrient Enriched Hilly Black Rice in Charland Areas of Bangladesh

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Abstract
Black rice, is a type of rice that belongs to the *Oryza sativa* L. species. In ancient China, it's said that black rice was considered so unique and nutritious that it was forbidden for all but royal family. In Bangladesh, the black rice is being cultivating in the remote hilly areas including Bandarban district as jhum cultivation crop without any agronomic management practices and hence giving very low yield. There were series of experiments performed. The current experiment was to set to establish a suitable weed management method for black rice cultivation.To fulfill the objective one experiment was laid out which was comprised of two cultivars viz. Bangladeshi black rice (Kongnamene) and Indonesian black rice (Ketan hitam) and nine weed management methods viz. no weeding (W_0), two hand weeding at 20 and 40 days after transplanting (W_1), three hand weeding at 20 , 40 and 60 days after transplanting (W_2), application of Post-emergence herbicide (W_3), application of Pre-emergence herbicide (W_4), application of Post-emergence herbicide and one hand weeding at 35 DAT (W_5), application of Pre-emergence herbicide and one hand weeding at 35 DAT (W_6), application of Pre-emergence herbicide and Post-emergence herbicide (W_7), weed Free (W_8). The experiment was laid out in Split-plot design with three replications. Results revealed that weed parameters, growth parameters, crop characters, yield contributing characters and yield retarding characters were significantly influenced by the interaction of cultivars and weed management practices. Significantly highest grain yield (5.68 t ha^{-1}) and straw yield (7.96 t ha^{-1}) were recorded from V_1W_5 other than the weed free condition. Maximum weed control efficiency (82.57 %) was obtained from V_1W_5 other than the weed free condition. Considering the BCR, the highest value (2.28) was obtained from V_1W_5. Though the maximum yield was obtained from weed free condition but considering the BCR, cultivation of Indonesian black rice cultivars (Ketan hitam) with the application of early post-emergence herbicide and one hand weeding at 35 DAT might be the best practice for better output from black rice cultivation.

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Tank-mix Combination of Available Herbicides for Better Weed Management in No Till Non-puddled Transplanted Boro Rice

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Abstract
An essential component of any weed control technique are herbicides. The current reliance on herbicides calls for a more sophisticated strategy, especially with regard to proper application methods. Use of herbicide mixtures is one of the techniques that may reduce the risk of evolution of resistance in weeds which is a great concern worldwide. In emerging nations like Bangladesh, these tactics require further consideration.Although some proprietary herbicides (commercial mixture) are available in the market, their numbers are very limited. Tank-mixture of two or more chemical groups of either pre- or post-emergence herbicide might play a vital role to manage weeds of a diversified community more effectively. Although reports related to tank-mix herbicide application on some dryland crop fields have been found in literatures, in rice field it is very meagre especially in Bangladesh context. Considering all these issues, this research has been conducted to evaluate the performance of tank-mix combination of sixpre- / post-emergence herbicides along with their 13 [either pre- (Exp.#1) or post- (Exp.#2)] tank-mix combinations to control rice weeds in no till non-puddled transplanted condition. One proprietary and one weedy plot was also included as control. Both experiments were laid out in a randomized complete block design with three replications. The results revealed that selected herbicides and their tank-mix combinationshavesignificant effects on weed suppression and grain yield.In case of pre-emergence herbicide (Exp.#1), the highest weed dry weight wasobservedin season-long weedy (control) plots, while the lowest onewas observed in the plots whereTriafamonewas applied as sole followed by proprietary herbicide,and tank-mix Pretilachlor + Triafamoneat all dates of measurement. In addition, the highest number of total tillers hill^{-1}, effective tillers hill^{-1}, grains panicle^{-1}, and highest grain and straw yieldwere also obtained from Triafamonesole applied plots followed by tank-mix Pretilachlor + Triafamone.In case of post-emergence herbicide (Exp.#2), the lowest weed dry weight,tallest plant, highest number of total tillers hill^{-1}, effective tillers hill^{-1},total spikelets panicle^{-1}, number of grains panicle^{-1}, 1000- grain weight, grain yield were recorded from the plots wheretank-mix Pyrazosulfuron-ethyl + Penoxsulam was applied. On the other hand, the highest weed dry weight and the lowest number of all yield attributes and grain yield were obtained from season long-weedy (control) plot. Based on these results, it may conclude that farmers may apply pre-emergence herbicide Triafamone as sole or Pretilachlor + Triafamone as tank-mix, or post-emergence herbicidePyrazosulfuron-ethyl + Penoxsulam as tank-mix for better weed suppressionand to obtain higher grain yield under no till non-puddled condition.

Crop and Weed Response to different Tank-Mix Herbicide Combinations in Zero Till Non Puddled Rice

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Abstract
Herbicides are normally applied as single or in sequence by the farmers of Bangladesh to control weeds. Tank-mixture of two or more chemical groups of either pre- or post-emergence herbicide might play a vital role to manage weeds of a diversified community more effectively. Although some proprietary herbicides are available in the market, their number is very limited. In this backdrop, the current research was conducted to evaluate the crop and weed response to tank-mix pre- or post- emergence herbicide combinations to control weeds of transplant *boro* rice under zero-till non puddled condition. A total of 21 treatments were used in each experiment (either pre- or post-emergence herbicide). Both the experiments were conducted under randomized complete block design with three replications. In case of pre-emergence herbicides, sole application of Triafamone performed as the best in terms of percent weed control efficiency (%WCE) and yield increase over control (%YOC). The second highest %WCE was observed in the proprietary pre-emergence herbicide Acetachlor 14% + Bensulfuron methyl 4%, while, second highest %YOC was obtained from the tank-mix Pretilachlor + Triafamonepre-emergence herbicide. In case of post-

emergence herbicides, tank-mix application of Pyrazosulfuron-ethyl + Penoxsulam performed as the best in terms of %WCEand %YOC followed by sole application of Penoxsulam. In both experiments, the lowest performance of %WCE and %YOC was observed in season-long weedy plots. As these experiments have been conducted in a single season and single location, it is not wise to draw a final conclusion based on these experimental results. Multi-location and multi-season trial considering different tank-mix ratios should be taken into account in future to draw a concrete conclusion based on these preliminary experimental results.

Characterization and Conservation of Rice Germplasms Collected from Different Ecosystems of Bangladesh

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Abstract

Forty-one Aman rice germplasm were evaluated to assess their morphological variability and genetic diversity considering ten quantitative and qualitative traits at the field experimental plot of Bangladesh Institute of Nuclear Agriculture, Mymensingh, following randomized complete block design. The germplasm showed significant differences for all the studied traits. The highest grain yield/plant was recorded in Sentu-16 whereas the lowest was found in Gaindha. The genotypic coefficient of variation (GCV) was lower than those of the corresponding phenotypic coefficient of variation (PCV) for all the traits. High PCV and GCV along with heritability, genetic advance (GA) and GA in percentage of mean were recorded for number of filled grains/panicle and number of unfilled grains/panicle. Grain yield/plant had positively significant correlation with plant height, number of total tillers/hill, number of effective tillers/hill, number of filled grains/panicle and thousand grain weight. Path coefficient analysis suggested that grain yield/plant had positive direct effect in association with days to fifty percent flowering, number of effective tillers/hill, panicle length, number of filled grains/panicle and thousand grain weight. Principal component analysis revealed that the first three components accounted for 79.57% of cumulative variance. Cluster analyses were revealed that the studied rice germplasm organized into five clusters based on D2 values where maximum inter-cluster distance was observed between cluster II and V. Qualitative characterization by distinctness, uniformity and stability test revealed that a wide range of variation was observed among the genotypes. Therefore, this study would be useful for breeders to choose and identify the revival and preservation of beneficial genes for crop improvement.

Improving Crop Productivity Through Adoption of Climate Resilient Cropping Systems in the Selected Charland of Bangladesh

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Abstract

Crop productivity and cropping intensity in the charland ecosystem is very low due to lack of different interventions like use of modern crop varieties, not following different improved cropping patterns by inserting short duration high yielding crop varieties in the existing low yielding pattern. Moreover, flash flood, low organic matter content of soil, lack of moisture in the dry season are also responsible for such result. Considering the above fact a study was undertaken to improve the crop productivity by inserting crops/crop species in the existing rice based pattern. A survey was undertaken to enquire the existing crops and cropping systems of the Charland and it was found that Boro rice-fallow-T.Aman rice is the dominant cropping patterns. Later, short duration/water saving Aman and Boro rice varieties were identified through evaluating different modern rice varieties. A number of profitable crops like vegetables, mustard, maize, groundnut and onion etc were inserted in the pattern. Therefore, interventions were given to improve rice productivity and also to increase crop diversity and cropping intensity in the area. Later on four profitable patterns were identified and these patterns were evaluated at two locations to identity the most profitable improved patterns by considering yield and benefit cost ratio.

Silicon-Mediated Aluminiumtoxicity Resistance in Wheat Seedlings

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Abstract
Aluminium (Al) toxicity in acidic soil is one of the major constraints in wheat growth and development, and silicon (Si) can play an important contribution in reducing Al toxicity. However, limited information is available on the effects of Si to alleviate the negative effects of Al toxicity in wheat. In this net house experiment, wheat (BARI gom34) was grown to the vegetative stage (Zadoks 23) with or without foliar Si application (4- and 10-mM Si/L), cultivated in Al-toxic soil (75 mg Al/kg soil) with or without Si amendment (100 and 250 mg Si/kg soil). The experiment was conducted following randomized complete block design with four replications.Applying Si (@10 mM/L) to the foliage significantly increased shoot dry weight (by 37.3%), root dry weight (by 17.6%), total root length (by 69.7%) and total chlorophyll (by 43.2%) compared to the plants grown in Al-toxic soil. Besides, soil Si application (@250 mg/kg soil) also significantly increased shoot dry weight, root dry weight, root length, and total chlorophyll by 39.2%, 34.5%, 164% and 28.4%, respectively. The results also revealed that shoot Si concentration significantly increased by 3.7- and 3.4-fold in foliar and soil Si treatments compared to the plants grown in Al toxic soil. Therefore, applying Si foliarly (10 mM Si/L) and to soil (250 mg Si/kg soil) might contribute to improved wheat growth when grown in Al toxic soils.

Restoration of Soil Fertility and Sustainable Rice Production by Quick Composting

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Abstract
Application of organic manures and composts with chemical fertilizers has been recognized as an eco-friendly sustainable agricultural practice for crop production. Field trials were conducted for two years at two sites *viz.*Soil Science Field Laboratory of Bangladesh Agricultural University and a farmer's field at Char Nilokhyia of MymensinghSadar for Boro-T.Aus-T.Aman cropping pattern to investigate the effect of quick compost with organic manures and inorganic fertilizers on rice yields, nutrient uptake and soil fertility. Both the experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications and nine treatments *viz.* T_0: Control, T_1: 100% RFD (Recommended Fertilizer Dose), T_2: 75% RFD, T_3: 75% RFD + quick compost 5 t ha^{-1}, T_4: 75% RFD + quick compost 2.5 t ha^{-1}, T_5: 75% RFD + quick compost 2.5 t ha^{-1}+ poultry manure 2.5 t ha^{-1}, T_6: 75% RFD + quick compost 2.5 t ha^{-1}+ cow dung 2.5 t ha^{-1}, T_7: 75% RFD + quick compost 2.5 t ha^{-1}+ mustard oil cake 2.5 t $ha^{-1}$and T_8: 75% RFD + quick compost 2.5 t ha^{-1}+ash 2.5 t ha^{-1}. In both locations, the integrated nutrient management significantly improved production of rice with higher nutritional quality and nutrient use efficiency. Among the treatments, the performance of mustard oil cake (T_7) was the best for both years causing the maximum yields, nutrient uptake and use efficiency of rice followed by poultry manure (T_5) and cow dung (T_6). Besides, using quick compost with organic manures significantly improved organic matter content, CEC, total N, exchangeable K and available P and S of the post-harvest soils. Therefore, quick compost @ 2.5 t ha^{-1}should be applied with mustard oil cake or poultry manure and inorganic fertilizers for improvingrice yield, nutrient uptake and soil fertility.

Sustaining Soil Fertility and Improving Crop Productivity in Rice-Based Cropping System by Integrated Use of Organic and Inorganic Sources of Nutrients

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Abstract
Excessive fertilization is one of the major threats in soil health management strategies worldwide. Although various soil amendments have been widely applied in agricultural crop production, their effects remain variable. Boro rice-Fallow- T. Aman rice cropping pattern with seven fertilization treatmentsincluding no additional nutrient supply (T_0), chemical fertilization according to farmers' field (T_1), recommended dose (RD) of chemical fertilizer (T_2), and 25 % RD of fertilizer T_2 in combination with farmyard manure (5 ton/ha; T_3), poultry manure (3 ton/ha; T_4), compost (10 ton/ha; T_5), and green manure (T_6) were tested with three replications under randomized complete block design (RCBD) at field condition.Dhaincha was grown in fallow period and organic amendments were only applied in T. Aman rice, the residual effect was observed in boro rice. All four organic amendments had similar grain yields, while all had significantly higher yields over control and ranged from 3.01 in T_0 to 6.33 t ha^{-1} in T_6. Soils with organic amendments and chemical fertilizer had more than 50-52% higher grain yield and more than 47-50% higher straw yield over control. The nutrient uptake was measured and in both seasons the higher uptake was in T_6. In post-harvest soil the carbon stock was higher in T_6than in other treatments; however, treatments had no significant impact on soil nitrogen. Itcan be concluded that combinations of chemical and differentorganic nutrientsourcesare effective in reducing recommended dose of chemical fertilizers up to 25% while additionoforganicamendmentscanincreaseSOCby12-26%overcontrol and green manuring will be a promising practice among the organic amendments to get more yield, nutrient uptake, and post-harvest soil quality, which are the major factors related to rice yield and soil quality.

Mitigation of the Adverse Effects of Soil Salinity in Hybrid Maize by Organic Amendments

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Abstract
Salinity is a major limiting factor for crop production in coastal areas of Bangladesh. Organic amendments could contribute to the improvement of crop production in coastal areas. A pot experiment was carried out in the net house of the Department of Soil Science, Bangladesh Agricultural University, Mymensingh to investigate the mitigation of the adverse effects of soil salinity in maize by using organic amendments. BARI Hybrid Maize-9 was used as the test crop. Cowdung, poultry manure (PM) and compost were added to the soils before seed sowing. The experiment was laid out in a completely randomized design with three replications. There were nine (9) treatment combinations consisting of control, 30 mMNaCl, 60 mMNaCl, 30 mMNaCl + Cowdung (5t/ha), 60 mMNaCl + Cowdung (5t/ha), 30 mMNaCl + Poultry manure (3t/ha), 60 mMNaCl + PM (3 t/ha), 30 mMNaCl + Compost (6t/ha), 60 mMNaCl + Compost(6t/ha). Plants were exposed to different concentrations of NaCl at vegetative stage. Salt stress caused a significant reduction in growth and yield of the maize variety. High salt stress (60 mMNaCl) caused a drastic decrease in growth and height of the maize variety. Salt stress also decreased K^+/Na^+ ratio, nutrient contents and nutrient uptake in maize variety. Organic amendments with Cowdung, Compost and PM improved salt tolerance of maize that were associated with increased plant height, plant weight, root length, root weight, K^+/Na^+ ratio and nutrient uptake in mild stress (30 mM) than in strong (60 mM). BARI Hybrid Maize- 9 conferred tolerance to high salinity, when soils were amended with cowdung or PM than compost. Organic amendments confer tolerance to salinity in maize by increasing plant growth, nutrient uptake and K^+ Na^+ ratio. The present study suggests that BARI Hybrid Maize- 9 can be recommended to cultivate for grain production and fodder crop with organic amendments in saline affected areas of Bangladesh since soil amendments with organic manures improved electrical conductivity and organic matter status under salinity condition.

Effects of Cadmium Contamination on Growth, Yield and Cadmium Concentration in Different Varieties of Boro Rice

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Abstract
Rice, the traditional staple food for the Bangladeshi population is one of the major exposure routes of cadmium for humans. A very few studies have looked into cadmium accumulation by different rice varieties in Bangladesh. This study examined the effects of cadmium contamination on growth, and yield and evaluated the varietal resistance against cadmium toxicity to select the best rice varieties. A pot experiment was carried out at the Soil Science Field Laboratory of Bangladesh Agricultural University, Mymensingh, during the Boro season to grow ten rice varieties. Cadmium was added at two rates viz. 0, 15 mg kg^{-1} (on a soil basis) from cadmium nitrate tetrahydrate ($Cd(NO_3)_2.4H_2O$). The varieties were BRRI dhan29, BRRI dhan47, BRRI dhan50, BRRI dhan92, BRRI dhan100, BRRI dhan102, Binadhan-8, Binadhan-25, Hybrid-5 and Local. The experiment was laid out in a completely randomized design with three replications. An amount of 18 kg of soil was taken in each pot. All pots received 3.2 g urea, 0.98 g TSP, 2.3 g MoP, and 0.9 g gypsum, respectively as a source of N, P, K and S. Data on the growth parameters, grain and straw yields were recorded. The N, P, K, S, Zn and cadmium concentrations in rice grain were analyzed. Cadmium contamination significantly reduced the effective tillers $hill^{-1}$, plant height, panicle length and filled grains $panicle^{-1}$. Rice yield and grain quality were also reduced with increased toxicity level. Cadmium contamination increased the grain cadmium concentration but reduced the concentrationof N, P, K, S and Zn. BRRI dhan100, BRRI dhan92, BRRI dhan47 and BRRI dhan102 had the lowest grain cadmium concentration when grown without any cadmium applicationand Binadhan-25 (1.18 mg kg^{-1}) showed the highest grain cadmium concentration whengrown with 15 mg kg^{-1} cadmium. Hybrid-5 had the highest grain yield (146.81g pot^{-1}) followed by Binadhan-25 (130.27 g pot^{-1})and Local (129.84 g pot^{-1}). The average daily intake of cadmium for adults and children from rice grain was higher when rice is grown in 15 mg kg^{-1} cadmium application than grown without cadmium addition. All rice varieties showed high Hazard Quotient (HQ) and Incremental Lifetime Cancer Risk (ILCR) values under 15 mg kg^{-1} cadmium in soil posed a serious health risk to humans. The HQ and ILCR values ranged from 0.16 to 6.47, and 0.02×10^{-4} to 0.97×10^{-4}, respectively, for a Bangladeshi adult due to the application of 15 mg kg^{-1} cadmium for different Boro rice varieties. The highest HQ (6.47) and ILCR (0.97×10^{-4} mg kg^{-1} BW) values were found in BRRI dhan25 at 15 mg kg^{-1} cadmium for the adult population. The susceptibility of the varieties due to the application of 15 mg kg^{-1} cadmium may be ranked as Bina dhan25>Local>BRRI dhan92> BRRI dhan102> Binadhan-8>Hybrid-5> BRRI dhan100> BRRI dhan29> BRRI dhan47> BRRI dhan50.

Silicon, an Alternative of Agrochemicals for Improving Grain Quality and Yield of Rice in Bangladesh

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Abstract
Silicon (Si) is the second most abundant element in the soil. It is a beneficial element for crop growth, especially for crop yield. Rice has specific mechanisms for assimilating Si from the soil as soluble silicic acid, which defense against biotic and abiotic stresses such as herbivory, leaf microbial pathogen resistance, toxic metal stress and drought tolerance. The experiment focuses on the highly leached Pleistocene terrace soils and calcareous floodplain soil to know the efficacy of Si to replace the agrochemical demand in rice. Field trials were conducted at four farmer's fields, taking one farmer from each village and two villages from each soil type. The most commonly used, high-yielding rice cultivars were used; BRRI dhan81 during the rabi season (January- May 2021& 2022) and BRRI dhan71during the wet season (June-October 2021& 2022). Experiments were conducted on 5m x 5m plots. Six treatments were used in the experiments. The treatments were: T_1–control, T_2-farmer's fertilizer practices, T_3-Soil test based fertilizer(STB), T_4-Silicon rich household ash (complete K supplementation) with STB, T_5-Silicon rich

biochar (complete K supplementation) with STB and T_6-Silicon fertilizer (SiO2) with STB fertilizer. The result shows that among the four locations, maximum rice grain was found in T5 treatment(6.47 t ha^{-1}) and maximum straw was found in T4 treatment (7.47 t ha^{-1}) in calcareous Terrace soil during the Boro season. On the other hand, among the four locations, maximum rice grain (6.63 t ha^{-1}) and straw (7.13 t ha^{-1}) were found in T6 treatment, which also produced calcareous terrace soil in the T. Aman season. Si fertilizer and Si rich amendments improved rice yields by more than 10% across the locations. Different Si-rich amendments effectively reduced the concentration of heavy metals in pore water. The lowest arsenic (As) was found in the T_6 treatment and the highest in the T_2 treatment. The application of Si fertilizer or Si-rich amendments has excellent potential for increasing rice yield by at least 10% and reducing heavy metal uptake in grain.

Estimating Nitrogen Management Indices: A Guide to Efficient Fertilizer Nitrogen Management for Better Crop Production and Climate Change Mitigation

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Abstract
Sustainable nitrogen (N) management represents the nitrogen-use efficiency(NUE) of crops associated with agricultural productivity. The NUE and sustainableN management index (SNMI) of different crops were evaluated with twolevels of crop residues (no residue, NR vs. 30 cm residue, CR) and four levels ofN fertilizers (control, CL; farmers' practice, FP; national recommended dose,RD; and 125% of RD, 1.25 RD) on intensively managed potato, maize and rice-basedcropping systems during 2020–2022. Increasing N fertilizationincreased winter and monsoon rice yields, while the effects were similar forpre-monsoon rice. Despite site and season specific, NUE showed mixedeffects of CR and N rate interaction, being higher in CR-1.25 RD for rice andpotato but lower for maize. Likewise, SNMI was lower in 1.25 RD coupled withCR for rice and potato but opposite for maize. Despite NUE corresponds wellwith the SNMI, the latter fits better with the crop yield, nutrient uptake,N requirement and N use model, suggesting that SNMI predicts optimumN management. Using the SNMI, a scatter diagram-based model optimizedN fertilization for crops were: 169, 152, 157, 82, and 102 kg N ha−1 for potato, maize, winter rice, pre-monsoon rice and monsoon rice respectively.

Development of a Yield-Scaled Nutrient Balance Calculator for Crops of an Intensively Managed Cropping Systems

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Abstract
Maize production requires a large amount of nitrogen (N). However,a greater part of the N used gets lost to the environment as reactiveforms including nitrous oxide (N_2O). N_2O emissions and associatedsoil-related factors were measured in a maize (*Zea mays* L.) field inthe 5th crop after initiation of the experiment in an annual maizericesequence. The treatments comprised two levels of crop residues (no residue, NR vs. 30 cm residue, CR) with four levels ofN fertilizers (control; farmers' practice, FP; national recommendeddose, RD, and 125% of RD, 1.25 RD). Mean and cumulative N_2O emissions increased with N rate coupled with either residuelevel. The CR coupled with 1.25 RD had 10% higher N_2O emissionsthan the same rate as NR. In contrast, yield-scaled N_2O emissionswere equal in 1.25 RD coupled with either residue level. However, higher N_2O emissions in CR than in NR can be offset by the correspondingimprovement in soil elemental quality, e.g., soil organiccarbon, total N, P, K and S. The N_2O emission factor, ranged from0.99 to 1.34, and was higher in CR coupled with 1.25 RD than in anyother combination suggesting that optimization of N rate is one ofthe best options to reduce N_2O emissions. Maize grain yield was higher in RD and 1.25 RD than in the farmers' practice where theformer two were similar to each other. Step-wise multiple regressionshowed that N application rate, soil organic carbon, total N andpH are the

dominant factors controlling N_2O emissions. Our resultssuggest that maize production can benefit from residue retentionwith the current N rate (RD) for better yield, soil quality and N_2O mitigation.

Biochar with Nitrapyrin Reduces Ammonia Volatilization and Increases Nitrogen Use Efficiency of Cabbage: A 15n Tracer Study

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Abstract

Nitrogen use efficiency (NUE) in subtropicalcropping systems is low causing a large quantityof reactive N loss to the environment. However, themechanisms and pathways of such losses are poorlyunderstood. The objectives of the research were toquantify N volatilization rates and correspondingNUE in a biochar and nitrapyrin-treated cabbage fieldusing N-control as well as a 15N-based approach.The treatments consisted of: N-control,urea alone, urea with nitrapyrin (UN), urea withbiochar (UB), and urea with biochar and nitrapyrin(UNB). In each plot, ^{15}N-labeled urea was applied in 0.16 m^2 micro-plots to repeat the treatments.The UNB had higher ($p < 0.001$) crop yieldsthan other treatments by 29, 23 and 16% over theurea, UN and UB treatments, respectively, while theUN and UB were also higher than the urea alone. Theestimated ^{15}N-based NUE was higher ($p < 0.01$) in theUNB (40%) than in the urea alone (32%) but similarto the UN (36%) and UB (38%). The N-controlbased calculation overestimated NUE by 2–13% relativeto the 15N-based approach. The UNB treatmentreduced NH3 volatilization by 37, 22, and 33% overurea alone, UB and UN, respectively ($p < 0.01$). Postharvestsoil organic carbon (SOC) and total N werehigher ($p < 0.001$) in the UNB and UB treatmentsthan the other treatments.Our results with a subtropical crop suggestthat biochar alone or co-applied with nitrapyrinimproves NUE and mitigates NH_3 volatilization whileincreasing SOC and TN contents.

Nutrient Management for Diversified Cropping in Bangladesh

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Abstract

Wetland rice cultivation contributes significantly to global warming potential (GWP), aneffect which is largely attributed to emissions of methane (CH_4). Emerging technologies forwetland rice production such as conservation agriculture (CA) may mitigate greenhousegas (GHG) emissions, but the effects are not well defined. Investigations were carried out inan irrigated rice (Boro rice) field in the fifth crop after conversion of conventional tillage (CT)to strip tillage (ST). Two crop residue levels (low versus high, LR versus HR) and threenitrogen (N) application rates (N1 = 108, N2 = 144, and N3 = 180 kg N ha^{-1}) were laid out ina split-plot experiment with three replicates. Yield-scaled GHG emissions and GWP wereestimated to evaluate the impacts of CA on mitigating CH_4 and N_2O emissions in the ricepaddy field. There was a 55% higher N_2O emission in ST with HR coupled with N3 thanthat in CT with LR coupled with N1. The N_2O emission factors ranged from 0.43 to 0.75%in ST and 0.45 to 0.59% in CT, irrespective of the residue level and N rate. By contrast, CH4emissions were significantly lower in CA than in the conventional practices (CT plus LR).The ST with LR in N2 reduced the GWP by 39% over the GWP in CT with HR in N1 and16% over the conventional practices. Based on our investigation of the combination oftillage, residue, and N rate treatments, the adoption of CA with high and low residue levelsreduced the GWP by 10 and 16%, respectively, because of lower CH_4 and N_2O emissionsthan the current management practices. The relatively high N_2O emission factors suggestthat mitigation of this GHG in wetland rice systems needs greater attention.

Salinity Stimulated Nutritional Imbalance of Rice and Its Risk to Coastal Community of Bangladesh

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Abstract
Salinity is considered one of the important environmental factors affecting rice (*Oryza sativa* L.) production. According to the Soil Resource Development Institute (SRDI) (2010), about 1.2 million hectares of arable land are affected by soil salinity out of 2.85 million hectares of coastal land in Bangladesh. Knowledge of the effects of salinity on the nutrient status of rice is necessary for reducing malnutrition and improving food security in salinity-affected areas. This study was designed to evaluate the effects of salinity on the nutrient status of different local and HYV rice varieties. The soil and rice grain samples would be collected from the farmers' fields of Katianagla village under BatiaghataUpazila of Khulna district. Farmer's cultivation procedure would be followed with salt-tolerant and sensitive cultivars for evaluating the loss of nutritional qualities due to salinity. Initially, some locally cultivated rice varieties such as Chinikanai, Raniselut, Bashfulbalam, Benapole, Kumroghor, Kataribhog, and some high-yielding varieties such as BR8 (Shahjalal), BRRI dhan87, BINA dhan16 and IRRI 23 are selected for T. aman season (2023). Five salt-tolerant rice varieties (BINA dhan8, BINA dhan10, BRRI dhan67, BRRI dhan97, BRRI dhan99) and five sensitive rice varieties (BINA dhan5, BINA dhan24, BINA dhan25, BRRI dhan89, BRRI dhan92) are selected for Boro Season (2024). Soil samples would be analyzed to determine quality parameters such as Electrical Conductivity (EC) and Cation Exchange Capacity (CEC). Following the standard methods, Chemical analyses ofrice grain samples will be done for nitrogen, crude protein, amino acid, phosphorus, potassium, sulphur contents, and also several essential macro and micronutrients such as Zn, Fe, and Se, etc.

Life History Parameters of Spider Mite *Tetranychusmacfarlanei* on Different Host Plants and Their Eco-Friendly Management

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Abstract
Spider mites are an incessant potential danger to many food and ornamental plants. Higher reproductive potential and rapid development is the basis for increasing the capacity of population of spider mites. Among different species of spider mites, *Tetranychusmacfarlanei* is the serious pests infesting different agricultural crops. This species recorded a broad host range with a potential distribution pattern in Bangladesh. Here different varieties of bean, e.g., BARI Shim 6, 7 and 8, and mashkalai used to determine their population growth using Two-sex MS-CHART program. Host plant species significantly influenced the developmental times, oviposition period, longevity, fecundity, and life table parameters of *T. macfarlanei*. Age-stage specific survival rates (S_{xj}), age-specific survivability (l_x), age-stage specific fecundity (f_x), age-specific fecundity (m_x), age-specific maternity (l_xm_x), age-stage life expectancy (e_{xj}) and Age-stage fecundity (v_{xj}) of *T.macfarlanei* varies on different host plants. The intrinsic rate of natural increase of *T. macfarlanei*was higher on BARI Shim- 6 than the other two bean varieties, and lowest on *Vigna mungo*, suggesting that BARI Shim- 6 was a more suitable host plant for a population increase of the spider mites, *T. macfarlanei*. Abamectin, Chlorpyriphos, Fenvalerate, imidacloprid, lufenuron and deltamethrin (1%) + Triazophos (35%) were used against the eggs and adults of *T. macfarlanei*. Abamectin and fenvalerate was found to be most effective both in egg and adult stages of *T. macfarlanei*.

Compatibility of Detergent to Increase the Efficacy of Different Pesticides Against Giant Mealybug, *Drosichamangiferae* (Homoptera: Pseudococcidae)

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Abstract

The giant mealybug, *Drosichamangiferae* (Homoptera: Pseudococcidae), is a polyphagous sucking insect pest that attacks various economically important tropical fruits, vegetables, and ornamentals. The waxy layer covering their bodies provides resistance against various insecticides. Therefore, the efficacy of commercially available biopesticides and chemical insecticides alone and after detergent application was investigated in the laboratory. The biopesticides (D-limonene and Matrine) showed varying effects on giant mealybug survivability. When applied individually, both had limited efficacy. D-limonene's effectiveness significantly increased when applied after the detergent, achieving a 75% mortality after 20 hours and exceeding 90% later. However, Matrine's effectiveness slightly increased when applied after the detergent, resulting in a lower efficacy. The effectiveness of chemical pesticides varied, influencing pest survivability. Abamectin and Chlorpyrifos had limited efficacy when applied individually. In contrast, Carbosulfan, Beta Cyfluthrin + Imidacloprid, and Cypermethrin showed higher efficacy against giant mealybugs. Applying these chemical pesticides after detergent significantly increased their effectiveness, resulting in higher mortality rates. Abamectin and Chlorpyrifos exhibited higher LT_{50} values, suggesting slower control when applied alone. However, their LT_{50} values significantly decreased when used after detergent, indicating improved efficacy. Carbosulfan, Beta Cyfluthrin + Imidacloprid, and Cypermethrin showed lower LT_{50} values, suggesting faster control when used alone. Sequential use after detergent application further lowered their LT_{50} values, indicating increased control efficacy. The study emphasizes the importance of considering the sequencing of detergents and pesticides for optimal control. Finally, detergent toxicity on plants should be considered for a comprehensive understanding of environmental impact.

Comparative Efficacy of Entomopathogens *Beauveria Bassiana* and *Paecilomycestenuipes* against Red Spider Mite *Tetraychusmacfarlanei* Baker & Pritchard (Acari: Tetranychidae) Under Varying Relative Humidity Conditions

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Abstract

Tetranychusmacfarlanei is a potential threat for various economically important crops. Chemical control is widely used to control this spider mite, but the exclusive reliance on chemical acaricides is now being questioned and entomopathogens are emerging as a promising alternative. The efficacy of the entomopathogens largely depends on abiotic factors like temperature, humidity, rainfall etc. The experiments were conducted to find out the effect of relative humidity on the efficacy of the entomopathogen *Beauveria bassiana* (strain GHA), marketed as BotaniGard ES, and *Paecilomycestenuipes*, marketed as Gotz A® ES against the adult female and egg stages of *T. macfarlanei* under laboratory conditions. Adult females and eggs of *T. macfarlanei* were treated with three concentrations of BotaniGard(1×10^6, 1×10^7 and 1×10^8 conidia/ml), and virulence was assessed on mites held at three relative humidity levels (55, 75, and 95 ± 2 % RH) at 25 ± 1 °C. The results showed that the mortalities of adult females and eggs of *T. macfarlanei* were dose-dependent and there is certainly a synergistic effect of relative humidity on the efficacy. When the eggs were treated under the above laboratory conditions, highest egg mortalities of 86.4 and 91% were recorded at a concentration of 1×10^8 conidia/ml at 75 and 95 ± 2 % RH, respectively, after six days of treatment in case of *B. bassiana*. The LT_{50} values on adult females were 28.7 h and 33.4 h at 95 and 75 ± 2 % RH in a concentration of 1×10^8 conidia/ml, which was significantly lower than values for other concentrations and RH

levels. In this study, 1×10^8 conidia/ml of *B. bassiana* at 75 to 95 ± 2 % RH was identified as the best possible combination than other lower RH to manage the spider mite. On the contrary, the egg mortality increased with the increasing the concentration from 1×10^6 to 1×10^8 conidia/ml at the same RH condition, and it was significantly higher at 1×10^8 conidia/ml at 95% RH than at 75 and 55 % RHs in case of *P. tenuipes*. The median lethal time (LT_{50}) for adult females was 41.1 hours at 95% RH and 49.8 hours at 75% RH when treated with a concentration of $1x10^8$ conidia/ml of *P. tenuipes*. This was significantly lower than the LT_{50} values at other relative humidity levels and concentrations. Thus, considering RH and incorporating other strategies is important when using biological control methods to effectively control this pest.

Morpho-molecular Identification, Distribution and Sustainable Management of Fall Armyworm (*Spodoptera frugiperda*) using Biopesticides, Botanicals, Chemicals and Si-based Resistance

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Abstract

Fall armyworm (FAW), *Spodoptera frugiperda*, is a highly destructive agricultural pest notorious for causing significant crop losses due to its adaptability and broad host range. Initially detected in East Africa in 2016, FAW has rapidly spread worldwide, reaching Bangladesh in 2018. Bangladesh's favorable climate facilitates FAW's establishment, leading to infestations and outbreaks that pose a severe threat to maize production. To combat the spread of FAW, effective monitoring and scouting methods utilizing sex pheromone traps are essential. In Bangladesh, twenty-six major maize-growing districts were selected for FAW monitoring, with five traps installed in each location. FAW was detected in 24 districts across Bangladesh using these traps, except for Sherpur and Moulvibazar. Observations revealed that FAW infestations are most prevalent during the early stages of maize growth, where larvae can inflict severe damage and even kill maize seedlings. Notably, FAW infestation initiates earlier in the southwestern region of Bangladesh, where maize cultivation begins earlier compared to other regions. The frequency of adult FAW captures using pheromone traps varied significantly over time and between districts. The northwestern and southwestern regions exhibited the highest frequency of male moth captures. This variation in moth captures reflects fluctuations in FAW populations. Effective monitoring and scouting using sex pheromone traps, combined with the implementation of robust management strategies, are crucial for mitigating the adverse effects of FAW on maize production in Bangladesh.

Assessment of Impacts of Pesticides Application in the Cultivation of High Yielding Maize Varieties in Bangladesh

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Abstract

In the present study, a cross-sectional surveywas conducted among four hundred maize farmers in Bangladesh to collect baseline informations regarding the scenario of pesticides use on maize as well as handling practices. During the survey period, we have identified 42 commercial insecticides under different chemical groups those were frequently used by maize growers. As many as 66% of the insecticides used by the maize farmers belonged to WHO toxicity class II (moderately hazardous) and 10% were under highly hazardous group (Ib).None of the farmers wore personal protective equipment (PPE) while majority of the farmers wore traditional clothes during pesticides application. It was also found that majority of the farmers did not follow recommended doses while making spray solution and disposed remaining solutions or empty bottles/packets in the same or neighboring fields. Different health problems were identified among the maize farmers who were experienced with pesticides application and a significant association was found between health problems and some risk factors. Besides survey study, two field

experiments were conducted in two major maize growing districts of Bangladesh to assess the effects of pesticides on the abundances and biodiversity of insect pests and beneficial arthropods. Results showed that beneficial arthropods were significantly reduced in insecticides treated plots than that of control under each functional group except pollinators. From Chuadanga district, a total of 78,751 and 48,216 insects were collected from 39 and 35 families respectively under control and farmers practice condition respectively. In case of Dinajpur district, a total of 70,019 and 43,061 insects were collected from 40 and 37 families under control and farmers practice condition respectively. Diversity indexes (both Simpson and Shannon-Wiener) were found higher in control plots than that of farmers practiced plot in both of the studied locations. In conclusion, adoption of *Bt* maize would be the safe and economical alternative in reducing pesticides use, health and environmental hazards as well as ensuring stable biodiversity in maize ecosystem.

Studies on the Temperature-Dependent Virulence of Two Entomopathogenic Fungi, *Beauveria Bassiana* and *Metarhizium Anisopliae* against Fall Armyworm, *Spodoptera Frugiperda*

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Abstract
In the present study, effectiveness of two microbial insecticides *viz*. *Beauveria bassiana* and *Metarhizium anisopliae* were evaluated against 2nd instars larvae of *Spodoptera frugiperda* under laboratory condition to elucidate the time-oriented and temperature dependent mortality. Both entomopathogens were evaluated using three different temperatures regimes *viz.* 10, 20 and 30°C under controlled temperature condition (light and thermal incubator). Two entomopathogenic fungi, *Metarhizium anisopliae* and *Beauveria bassiana* were tested against 2nd instar larvae of *S. frugiperda*. Two different doses for each isolates (4.0 & 5.0 g/L of *B.bassiana* and 3.0 & 4.0 g/L of *M. anisopliae*)were prepared for evaluation. The equal age and equal size of 2nd instar larvae were collected from mass culture and used to perform the current study. There were three replications with 20 larvae per replication which dipped in different concentrations for 20s. Then treated larvae having petridishes were transferred to thermal incubator to know the temperature effect on the mortality. On daily basis, new and fresh maize leaves were provided to larvae for feed. Nothing was used in controls except distilled water. The dose and time mortality responses caused due to fungal infection were observed and recorded. Mortality data were collected at 3, 7 and 10 days after treatment application. The larval mortality was dose, time and concentration dependent. The present results showed that among tested entomopathogenic fungi, *B. bassiana* was found more toxic and virulent than that of *M. anisopliae* at 30°Ctemperature. At 30°C, LC_{50} and LT_{50} value were also lower in case of *B. bassiana* than that of *M. anisopliae*. Less to moderate toxicity was found from 10 and 20°C. The current study concluded that entomopathogenic fungi especially *B. bassiana* @ 5.0g/L water can provide effective control against early instar and further studies are needed to check the efficacy against older instars under field conditions. Combined approach was found insignificant compared to individual application. Further studies are needed at field condition to validate the laboratory findings.

Assessment of Impacts of Some New Generation Insecticides on the Abundance and Biodiversity of Beneficial Arthropods in Brinjal Ecosystem

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Abstract
Biodiversity is the variability among living species in a community or ecosystem. The biodiversity of an agro-ecosystem is not only important for its intrinsic value but also because it may influence ecosystem functions that are vital for sustainable crop production and for the surrounding environment. Insect biodiversity in an ecosystem may vary due to the influence of different factors but uses of broad-spectrum synthetic pesticides are the most important

one. In the present study, impacts of some new generation insecticides *viz*. Suspend 5 SG (Emamectin Benzoate), Belt Expert 24 WG (Flubendiamide), Ravjum 14.5 SC (Indoxacarb), Plenum 50 WG (Pymetrozine), Prabal 10 EC (Alpha-Cypermethrin), Actara 25 WG (Thiamethoxam) were evaluated on the abundances and biodiversity of beneficial insects in brinjal ecosystem from July, 2022 to June, 2023 at the field laboratory of the Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh. The experiment was laid out in a Randomized Complete Block Design (RCBD) having three replications with three captured methods *viz.* sweeping net, pitfall trap and yellow sticky trap. Data were collected at 10 days interval and then sorted, counted and identified. In the present study, a total of 5790 insects were collected belongs to 27 species under 25 families and 10 orders. Considering the family, Hymenoptera was the most dominant order where 9 families were found that was followed by Diptera (5), Coleoptera (4), Hemiptera (2), Arenae (2) and others. Other orders namely Lepidoptera, Odonata, Dictyoptera, Dermaptera and Neuroptera those had only one family each. Based on the abundance, biodiversity and equitability index, Suspend 5 SG (a bacterial fermented pesticide) was found most safe insecticide in brinjal ecosystem among the tested six insecticides. Belt Expert 24 WG (Flubendiamide) and Ravjum 14.5 SC (Indoxacarb) were the most toxic and non-compatible insecticides to beneficial insects. Other three i.e. Plenum 50 WG (Pymetrozine), Prabal 10 EC (Alpha-Cypermethrin) and Actara 2.5 WG (Thiamethoxam) were found moderately safe and compatible to beneficial insects.

Bio-intensive Management of Caterpillar-Complex of Major Cruciferous Vegetables through Ecological, Eon-Chemical and Biorational-Based Holistic Approach

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Abstract
In this study, field experiments were conducted at the Entomology Field Laboratory, BAU, Mymensingh during the period from January 2021 to December, 2022 to develop an IPM approach consisting ecological, non-chemical and biorational insecticides in controlling caterpillar-complex on cabbage. In case of ecological and non-chemical approaches, approximately 27% head infestation was reduced, 28% head yield was increased over controland the highest BCR (1.53) was achieved from the integrated approach, push-pull technology + sticky traps + bait traps. Individual treatments were not much effective. On the other hand, Lumectin 10 WDG @ 1.5g/L showed the best efficacy in respect of the parameters studied that was followed by Capture 75 WDG @ 0.3g/L, Spinosad @ 0.6 ml/L and Fytomax @ 1.5 ml/L respectively. In case of holistic module or integrated approach, module-3 (all ecological approaches + Lumectin 10 WDG @ 1.5 g/L) provided the highest efficacy in reducing leaf and head infestation, highest yield (54.55 t/ha) and BCR (2.24) as well as abundances of beneficial arthropods in cabbage ecosystem that was followed by module-4 (all ecological approaches + Capture 75 WDG @ 0.3 g/L, module-2(all ecological approaches + Spinosad @ 0.6 ml/Land module-1 (all ecological approaches + Fytomax @1.5 ml/L)respectively. Thus, module-3 can be applied for the effective control of caterpillar complex on cabbage.

Evaluation of Some New Generation Insecticides Against Sucking Insect Pests of Brinjal and Assess Their Effect on Beneficial Predators and Parasitoids in The Field

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Abstract
Brinjal (Solanum melongena L.) is one of the most economically important vegetables in the world. Several sucking insects attack the brinjal plant from the seedling to fruiting stage causing severe yield loss. Aphids, jassid, whitefly, thrips and leaf hopper are identified as devastating sucking insects of brinjal plant. This study evaluated the effectiveness of selected new generation insecticides such as Pymetrozine, Buprofezin, Abamectin, Chlorfenapyr,

and Spinosad against sucking insect pests of brinjal under field conditions. The insecticides were sprayed four times at 15-days intervals with the first spray started when plant was 50 days old. The numbe of sucking insects, predatory ladybird beetle, and spider was counted by visual observation on the leaves of three randomly selected plants per plot after 7 days of each spray. Pymetrozine provided effective control of sucking insect pest and significantly lowest number of aphids, jassid, whitefly, thrips and leaf hopper were recorded in the brinjal fields. While, Chlorfenapyr was found less effective against sucking insect pests of brinjal. The abundance of predatory ladybird beetle and spider was also high in pymetrozine treated plants.

Assessment of Allelopathic Potentiality of *Wedeliachinensis* Against Stored Grain Pests

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Abstract
Post-harvest food commodities are seriously threatened by insect pests which causesa quarter to a third of the annual grain crop in the world is thought to be lost. Chemical pesticides have been widely employed in grain storage facilities to combat pest insects,which causes serious risks to the environment and to consumers.Stored grain insect pests should be controlled without applying chemical insecticides that cause enormous problems. For that, there is a pressing need to create secure substitutes that are ecologically benign. Allelochemicals can potentially be used as insecticides and antimicrobial crop protection products. This experiment was conducted to evaluate the allelopathic effect of Vimraj (*Wedeliachinensis)* leaf extract as an effective, safe and eco-friendly alternatives to protect stored grain products. The study followed a completely random design, with three replications for each treatment. The leaf extract at 100% methanol, 70% aqueous methanol and 50% aqueous methanol are used as treatment. Three doses of each treatment are used (10%, 7.5% and 5% of grain weight). Among the three conditions with three doses, we found that *W. chinensis* plant extract at 70% aq.methanol solvent showed the best activity on the mortality of all insects with doses 2 ml and 1.5 ml.Rice weevil mortality at the dose-3 of treatment-1, was lower than the other two pests. At treatment-2, the mortality rate of pulse beetle in dose-1 and dose-2 was lower than the other two insects and the mortality rate of red flower beetle in dose-3 was found to be lower than the rest. In treatment-3, the mortality rate of rice weevil at dose-1, dose-2 and dose-3 were higher than that of red flower beetle and pulse beetle. This treatment had the best results on rice weevil and least on red flower beetle.The 10% dose showed highest allelopathic effect on each pest, whereas 5% dose showed the lowest allelopathic effect. The effectiveness of the leaf extract was found to increase proportional with the increase of doses. This result indicate that this plant material has allelopathic potential on the mortality of stored product pests.Therefore, *W. chinensis* plant extractmight be used for the effective and eco-friendly management of these three pests. Though all the conditions showed activity on insect mortality, plant extract at 70% aq. Methanol solvent showed higher activity. So, this extract should be taken for further research.

Field Evaluation of Seed Treating Agent, Fortenza and Selected Biopesticides for Managing Fall Armyworm, *Spodopterafrugiperda* Je Smith on Maize

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Abstract
The field experiments were conducted to evaluate seed treating agent, Fortenza @ 4mlkg^{-1} and biopesticides, SfMNPV (Fawligen @0.1%), pheromone (Fall army-lure @ 1trap plot^{-1}), spinosad (Success 2.5% SC@ 0.5mlL^{-1}) and IGRs (Lumectin 10 WDG @ 1gmL^{-1}) on the infestation of fall armyworm (FAW) on maize plants as well as on the yield of the maize at Entomology Field Laboratory, Bangladesh Agricultural University, Mymensingh during December 2022 to June 2023. The experiments were laid out in Randomized Complete Block Design (RCBD) with three replications. Seeds were treated with Fortenza before sowing in the field. Biopesticides, SfMNPV, spinosad

and IGRs were sprayed at 10 days interval. The pheromone trap was set after starting of pest infestation and continued until harvesting and the lure was changed 1.5 months interval. Data were collected at 10 days interval. Data on the no. of infested plants plot^{-1}, no. of infested leaf (SFW & LW) plot^{-1}, no. of infested tassel plot^{-1}, no. of infested silk plot^{-1} and yield (t/ha) was calculated. All the treatments insignificantly reduced the infestation but the highest reduction was observed on SfNPV treated plants followed by spinosad and pheromone trap.The highest efficacy was showed by sfNPV followed by Spinosad at 10 DAS in case of leaf infestation.Though the yield did not vary significantly among the treatments but the highest yield was obtained from SfNPV treated plots followed by Fortenza and spinosad.

Management of Cucurbit Fruit Fly, *Bactroceracucurbitae* (Coquillett) Using Eco-friendly Approaches

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Abstract
Cucurbit fruit fly, *Bactroceracucurbitae* (Coquillett) is a devastating pest of different cucurbit vegetables and may cause more than 60% yield loss. To explore effective management strategy for this pest selected eco-friendly approaches were tested in the field of Bangladesh Agricultural University during July 2022 to June 2023. Eight treatments viz. T_1= yellow sticky trap T_2= white sticky trap, T_3= blue sticky trap, T_4= mashed sweet gourd trap, T_5= pheromone trap, T_6= spinosad, T_7=abamectin and T_8= control were evaluated against this pest on bitter gourd based on no. & weight of healthy & infested fruit plant^{-1}& plot^{-1}, respectively and yield of marketable fruits ha^{-1}. The effect of all the treatments always varied significantly ($P \leq 0.05$) than the untreated control. The highest number of healthy fruits per plant was found from the plants treated with spinosad and pheromone trap followed by white sticky trap treated plants. But the lowest mean number of healthy fruit per plant was recorded from the untreated plants. The highest mean number of infested fruit per plant was observed on the untreated plants and the lowest mean number of infested fruit was found from spinosad treated plants followed by MSG treated plants. Among the three coloured sticky traps, white coloured trap provided the best performance in case of all parameters studied but other two coloured traps were in statistically similar for protection of fruit. It was revealed that the highest mean yield per hectare was found from the spinosad treated plants and the lowest yield was obtained from the untreated control plants. The second highest yield was recorded from the plants treated with pheromone trap followed by white sticky trap treated plants. Therefore, spinosad and the coloured sticky traps might be used as eco-friendly and effective component for developing sustainable IPM packages to manage cucurbit fruit fly.

Isolation and Molecular Characterization Native Mosquitocidal *bacillusthuringiensis* Strains From Bangladesh and Their Pathogenicity Against Mosquitoes Ofmedical Importance

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Abstract
Bacillus thuringiensis (Bt) has been used for centuries in agriculture as environmentally friendly bio-pesticide. The insecticidal pore forming proteins known as Cry and Cyt toxins, produced by showed highly specific toxicity against Lepidopteran, Dipteran, Coleopteran and Hemipteran insects. The present work was undertaken to isolate and characterize the native Bt strains from native soils of Bangladesh for bio-pesticide development. A total of 76 soil samples were collected from 17 districts and the native Bt strains were isolated by the Enrichment method by spread plate method (dilution factor 10^{-7}) on Nutrient Agrarmedia. After incubation at 27°C for 48 hours, total number of colonies were measured and CFU (Colony Forming Unit) was calculated. Morphologically suspected Bt-like colonies were picked and Gram-positive rod-shaped bacteria were selected. Soil samples from Barishalhave highest viable microbial population (CFU value) following Rajshahi, Chuadanga and Gaibandha while the soils of

Panchagarh showed lowest. In gram staining test, among the 417 colonies analysed, 211 were found as Bt suspected. Among them, Jashore soils has highest Bt index value (1.00) whereas Rajshahi indexed lowest (0.33) Isolated colonies were stored and currently bio-efficacy analysis works are ongoing.

Assessment of Different Growth Substrates for Mass Production of Entomopathogenic Fungi for Biopesticide Development

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Abstract
The *Beauveria bassiana* is the most well-known Entomopathogenic fungi widely used throughout the world as biopesticideto control aphids, thrips, whiteflies, and different beetles. We previously isolated several *B. bassiana* strains from Bangladesh. For successful commercialization, a suitable media is required for mass spore production with minimum cost involvement. Hence, the current study was undertaken to evaluatedifferent growth media for mass production (biomass and spores)using local *B. bassiana* strain, Bb P-1-2 as an example. Eight Liquid media solidified with agar (Potato Dextrose Agar, PDA), PDA+Yeast, Sabouraud˝s Dextrose Agar (SDA), SDA+Yeast, Mollasse Yeast Agar (MYA), Jaggery Yeast Agar (JYA), Potato Carrot Agar (PCA) and PCA+Yeast was assessed by measuring radial growth, dry mass and spore production by inoculating 1 x 10^7 spores/ml as inoculum.All the tested media were found suitable for *B. bassiana* but SDAY was most suitable for profound growth of Bb. JYA, MYA and SDY produced higher amount of dry mass and spores.Significantly higher growth and spore produced at 17 DAI (days after inoculation) than 10DAI.Addition of Yeast significantly increase the growth and spore production.Similar, six solid media (Rice, Wheat, Maize, Chickpea, Groundnut, and Lentil) was also evaluated. Rice produced highest spores followed by Lentil, Groundnut and Chickpea.Thus, Sabouraud's Dextrose Agar+Yeast based liquid media and Rice, Lentil, Chickpea as solid media were found suitable for *Beauveria bassiana* mass production. These media could be used for mass production of entomopathogenic fungi for biopesticide development.

Collection and Characterization of Natural Enemies of Invasive Fall Armyworm*spodoptera Frugiperda* Threatening Food Security in Bangladesh

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Abstract
Maize (*Zea mays* L.) is the second principal cereal in the world serve as important source of different nutrients as well as phytochemical compounds. Several insect pests are responsible for lowering yield. Recently, infestation of a devastating invasive insect, Fall Armyworm (FAW) *Spodopterafrugiperd*a L. reported from Bangladesh threatening food security. However, the natural enemies of *S. frugiperda* from Bangladesh are yet to be identified and characterized. We have installed yellow pan, pitfall and malaise traps in maize field at Chuadanga, Iswardi, Kishoreganj, Mymensingh, Sherpur and Dinajpur. Insects were more captured in winter than summer. Collected insects were identified up to family level. Insects from Diptera, Hymenoptera, Hemiptera, Coleoptera, Lepidoptera, Collembola, Thysanoptera and Acarina were identified as the most abundant arthropods present in the maize ecosystem. Among them dipteran insects were highest (66.26%) in number and acarina (1.45%) were lowest in number. Beneficial insects belong to Braconidae (Braconid wasp), Ichneumonidae (Ichneumon wasp), Coccinellidae (lady bird beetle), Staphylinidae (rove beetle), Syrphidae (hover fly), chalcididae (chalcid wasp) etc. were found as natural enemies present in the maize field. The malaise trap showed the highest efficacy (72.25%) in capturing insects and natural enemies in both seasons. We hope our current data will help to formulate biological control of FAW and other major pests of maize in Bangladesh. Therefore, this study would be provided knowledge about FAW, its natural enemies, its abundancy and characterization of orders and family.

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Effect of Corm Size and Plant Growth Regulators for Corm Dip Treatment on Growth, Flower Yield and Corm Production of Gladiolus

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Abstract
Gladiolus is an important bulbous flower and plays an important role as cut flower both in domestic and international market. Demand for flower is increasing significantly in Bangladesh. Cultivation of gladiolus flower is gaining popularity among the farmers in various areas of the country. In order to enhance the yield and quality of gladiolus use of proper physiological mature corm is very important. Major constraint for gladiolus cultivation is the corm dormancy. Small sized corms take longer time for physiological maturity, hence the plant growth regulators can play a definite role to enhance plant growth and ultimately to shorten the cycle and increase the corm production. Therefore, keeping in view the role of growth regulators, the present study is under taken to evaluate the effect of growth regulators on the performance of gladiolus regarding flower and corm yield. The project is a two years project and comprising with three experiments. First year experiment is a two factor experiment laid out with Randomized Complete Block Design (RCBD) with 3 replications. One factor was corm size, such as C1=Small (Average weight 10-15 g), C2 = Medium (Average weight 16-20 g) and C3 = Large (Average weight 21-25 g) and the other factor is five levels of Gibberellic acidsuch as T1: Control, T2: GA_3 50 ppm, T3: GA_3 100 ppm, T4: GA_3 150 ppm, T5: GA_3 200 ppm. The experiment is now in the field and data collection is going on

Assessment of Yield, Nutritional Quality and Bioactive Compounds of Tomato Grown with Indole-3-Acetic Acid and Gibberellic Acid

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Abstract
The two factor experiment consisted of two different varieties of tomato; V_1: BARI Tomato-2 and V_2: BARI Tomato-15 and four different doses of plant growth regulators (PGRs) viz., T_0: Control (0 ppm PGR), T_1: 100 ppm of IAA (Indole-3-Acetic Acid), T_2: 100 ppm of GA_3 (Gibberellic Acid**)** and T_3: 100 ppm of IAA + 100 ppm of GA_3. The experiment was laid out in Randomized Complete Block Design with three replications. Tomato variety and plant growth regulators had significant influence on the growth and fruit yield and its nutritional value and bioactive compounds. The highest plant height (85.49 cm), the maximum number of leaves (26.00) and the minimum days (29.34 days) required for first flowering, the maximum number of flower clusters per plant (15.17), number of flowers per plant (37.50), number of fruits per plant (32.17) were observed in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3. The fruit length, weight and yield (96.44 t/ha) were the highest in the combination of BARI Tomato-15 and 100 ppm of IAA. On the other hand, the lowest yield (39.59 t/ha) was recorded in the combination of BARI Tomato-2 and 100 ppm of IAA + 100 ppm of GA_3. Results revealed that 100 ppm of IAA had provided 62.46% (87.19 t/ha) more yield than control (53.67 t/ha) in BARI Tomato-2. On the other hand, 100 ppm of IAA + 100 ppm of GA_3 reduced 26.23% (39.59 t/ha) yield as compared to control (53.67 t/ha) in BARI Tomato-2.Similarly, 86.29% (96.44 t/ha) more yield was obtained in BARI Tomato-15 when treated with 100 ppm of IAA than control (51.77 t/ha). On the other hand, 12.98% (45.05 t/ha) yield reduction occurred in BARI Tomato-15 when treated with 100 ppm of IAA + 100 ppm of GA_3 as compared to control (51.77 t/ha).Results revealed that 50% TSS, 23.64% TA, 24.64% ascorbic acid, 52.63% total chlorophyll, 65.62% lycopene, 53.38% TPC, 79.71% TFC, 22.47 % K, 17.98% P and 22.54% Ca of fruit increased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control and 8.93% p^H, 32.22% IC_{50} value of fruit decreased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control at stage 4 (consumption stage). At stage 6 (processing stage), 29.03% TSS, 35.71% TA, 24.40% ascorbic acid, 52.84% lycopene, 66.44% TPC, 87.78% TFC, 20.55 % K, 17.25% P and 26.27% Ca of fruit increased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control and 8.16% p^H, 32.72% IC_{50} value decreased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control.

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The Role of Exogenous Application of Indole-3-Acetic Acid on Growth, Yield and Nutritional Quality of Tomato

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Abstract
Single factor experiment consisted of four different doses of indole-3-acetic acid (IAA) viz., T_0: Control (no IAA, control), T_1: 50 ppm IAA, T_2: 100 ppm IAA and T_3: 150 ppm of IAA. The experiment was laid out in Randomized Complete Block Design with three replications. BARI Tomato-15 was used as experimental material. IAA had significant influence on the growth and fruit yield and its nutritional value and bioactive compounds. The highest plant height (85.49 cm), the maximum number of leaves (26.00) and the minimum days (29.34 days) required for first flowering, the maximum number of flower clusters per plant (15.17), number of flowers per plant (37.50), number of fruits per plant (32.17) were observed in 1500 ppm of IAA treatment. The fruit length, weight and yield (96.44 t/ha) were the highest in 100 ppm of IAA. 86.29% (96.44 t/ha) more yield was obtained when treated with 100 ppm of IAA than control (51.77 t/ha). On the other hand, 12.98% (45.05 t/ha) yield reduction occurred in BARI Tomato-15 when treated with 150 ppm of IAA as compared to control (51.77 t/ha).Results revealed that 50% TSS, 23.64% TA, 24.64% ascorbic acid, 52.63% total chlorophyll, 65.62% lycopene, 53.38% TPC, 79.71% TFC, 22.47 % K, 17.98% P and 22.54% Ca of fruit increased in 150 ppm of IAA than control and 8.93% p^H, 32.22% IC_{50} value of fruit decreased in 150 ppm of IAA than control at stage 4 (consumption stage). At stage 6 (processing stage), 29.03% TSS, 35.71% TA, 24.40% ascorbic acid, 52.84% lycopene, 66.44% TPC, 87.78% TFC, 20.55 % K, 17.25% P and 26.27% Ca of fruit increased in 150 ppm of IAA + 100 ppm of GA_3 than control and 8.16% p^H, 32.72% IC_{50} value decreased in 150 ppm of IAA than control.

Phenotypic Screening of Antioxidant Rich Tomato Genotypes for Improving Quality Traits of Cultivated Tomato Varieties

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Abstract
Tomato (*Solanumlycopersicum* L.) belongs to the family Solanaceae and is one of the most economically important vegetables in the world as well as in Bangladesh. According to the BBS, Bangladesh produced 442 thousand metric tons of tomato from 29.55 thousand hectares of land during 2021-2022. It is one of the most consumed vegetables in Bangladesh due its attractive color, delicious taste, excellent nutritional properties and year round availability. Fresh tomatoes and tomato-processed products are the reservoir of several antioxidants such as carotenes (lycopene, ß-carotene), ascorbic acid and phenolic compounds, flavonoids, anthocyanin and tannins. Due to the presence of these antioxidant phytochemicals and bioactive compounds, consumption of fresh tomato and tomato products reduces the risk of several chronic diseases like cardiovascular diseases, cancer, diabetes and rheumatoid arthritis. These properties of tomatoes have attracted the interest of many researchers for further genetic improvement by traditional breeding or through transgenic approaches. Genetic improvement of tomato requires a wide range of genotypic variability for the desired characters. Variability of antioxidant and other quality parameters has been observed in tomato genotypes.Although a good number of tomato varieties having high yield potential have been cultivated. However, information on nutritional properties including antioxidant content of tomato genotypes grown in Bangladesh is still lacking. Hence, it is important to screen and molecular characterization tomato genotypes having high level of antioxidant. Therefore, collection, conservation, evaluation and screening of tomato genotypes are still the thrust of research to develop antioxidant-rich tomato varieties for this country. In the current study, 40 genotypes were collected and their morpho-physiological, nutritional and anti-oxidant contents are in progress.

Co-Application of Potassium Nitrate, Hydrogen Peroxide and Calcium Chloride Reduces Salt-Induced Growth Inhibition of Tomato (*Solanumlycopersicum*)

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Abstract
Salinity is a key stress for successful agricultural production. The addition of various signaling molecules has been shown to reduce salinity stress. However, various exogenous chemicals limit plant stress tolerance through the induction of various plant physiological and biochemical processes. The aim of the study was to test the effectiveness of different signaling molecules in alleviating salt stress. In this study, the effects of 30 mM KNO_3, 0.2 mM H_2O_2, and 30 mM $CaCl_2$ were tested on the morpho-physiological and biochemical parameters of tomato plants subjected to 100 mMNaCl salt stress. The results showed that salt stress significantly reduced the plant height, leaf SPAD value, fresh and dry masses of shoots and roots, potassium, calcium, magnesium, and sulphur concentrations in leaves and roots, ascorbic acid, and relative water contents in the leaves compared to control plants. In contrast, sodium, proline, soluble sugar, hydrogen peroxide (H_2O_2), malondialdehyde (MDA), catalase (CAT), and ascorbate peroxidase (APX) significantly increased under salt stress compared to the control treatment. The application of exogenous signaling molecules, especially KNO_3, followed by $CaCl_2$ and H_2O_2 improved the growth characteristics of tomato plants, which decreased under salt stress. They also reduced leaf and root sodium concentrations, H_2O_2 and MDA concentrations, and increased leaf proline, soluble sugar, and CAT and APX activities. The effectiveness of applying exogenous signaling molecules to restore altered growth parameters of tomato plants under salt stress is KNO_3, $CaCl_2$, and H_2O_2. The findings also showed that applying these three compounds together was the most efficient way to reduce the detrimental effects of salt stress on tomato growth and development.

Sustainable Production and Storage of Summer Onion Using Household Organic Mulches

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Abstract
An experiment was conducted to study the effects of varieties and household organic mulches on growth and yield of onion at the Horticulture Farm of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from October 2022 to June 2023. The experiment consisted of three summer onion cultivars of Bangladesh viz. BARI Piaj 2, BARI Piaj 3 and BARI PiaJ 5, and five household organic mulches, viz. T_0 = Control (no mulching), T_1 = Vegetables wastes, T_2 = Cattle shed straw, T_3 = Banana leaf and T_4 = Leaf mold compost mixer. The two-factor experiment was carried out in Randomized Complete Block Design with 3 replications. Results revealed that the parameters under study showed significant variation between onion varieties and mulching. BARI PiaJ 5 gave the highest plant height, number of leaves, fresh weight and gross yield of bulb compared to BARI Piaj 3 and BARI Piaj 2. The effect of household organic mulches on yield were in order of $T_4>T_1>T_2>T_3>T_0$. Among the treatment combinations V_3T_4 gave the highest plant height (47.85 cm), number of leaves (14.01), fresh weight of bulb (52.87 g), percent dry matter content (13.13%), percentage of splitted bulb (10.33%) and gross yield of onion (18.24 t/ha). The highest percentage of dry matter content of bulb (13.13%) was recorded in V_3T_4 followed by V_3T_1 (12.54%). The lowest percentage of weight loss of bulbs (24.66%) was observed in V_1T_1 (Table 5). The result revealed that, leaf mold compost mixer with BARI Piaj 5 was shown to be more effective in increasing summer onion production and BARI Piaj 2 more effective in weight loss. Therefore, the combined application of leaf mold compost mixer along with BARI Piaj 5 was found to be better in respect of growth and yield and BARI Piaj 2 for storability of onion.

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Development of Nutritious Carrots for Stressful Environments

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Abstract
The experimentswereconducted at the Horticulture Farm of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh and Farmer's field of Tista charland, Kaunia Upazilla, Rangpur District during the period from October 2022 to February 2023. 56 cultivated carrot germplasm representing a wide range of pigmented carrot were used for this experiment. Plant collections (PI) and experimental inbreds developed by the USDA carrot-breeding program were grown for each genotype under optimal (control or continuous water) and stressful (drought) field conditions. An additional 24 carrot cultivars grown in Bangladesh were alsoincluded in this studies.The experiment was laid out in Split Plot Design with two replications. This study demonstrated that drought stress significantly decreased the morphological, physiological and yields parameters of carrot genotypes. Plant height, number of leaves per plant, root length and diameter, and marketable yield were reduced under drought stress but dry matter content of root and shoot increased with stress conditions.In physiological parameters, chlorophyll and relative water content decreased in drought stress condition whereas, proline content increased. The reduction rate of marketable yield was found to be the lowest in PI 419042 (7.06%) and PI 419184 (8.20%), and the highest in PI 249535 (75.61%) and PI 261650 (60.02%). Based upon wilting severity, the genotypes PI 419042, PI 419184, PI 264669 and PI 167143 showed tolerance to drought stress. Similar levels of drought tolerance were found for carrots grown in both field locations in Bangladesh, and also in greenhouse evaluations in the U.S. This provides compelling evidence for a strong genetic component for drought tolerance in carrots. Therefore, in summary, morphological, physiological, yield parameters and wilting severity indicated that the carrot genotypes PI 419042, PI 419184, PI 264669 and PI 167143 should be considered as drought tolerant genotypes and could be selected for breeding purposes.

Collection, Characterization and Conservation of Gladiolus Germplasm

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Abstract
The present study was conducted to collect, characterize and conserve of gladiolus germplasm during the period of January to December 2023 at the Landscape Section, department of Horticulture of the Bangladesh Agricultural University, Mymensingh. The experiment included 16 germplasm of gladiolus collected from different areas of Bangladesh and abroad. The single factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Significant variations were observed among different gladiolus germplasm. Early sprouting (80% sprouting) was found in germplasm G01 and G02 (13.67 days) while G12 needed maximum days (23.00). The germplasm G01 showed maximum plant height (91.08 cm) at 60 DAP followed by G11 (74.33 cm) and G10 (73.75 cm) whereas minimum plant height obtained from G16 (43.08 cm). Maximum leaf length was found in germplasm G01 (65.58 cm) and minimum leaf length was observed in G16 (38.00 cm). Leaf width was found maximum in germplasm G01 (4.50 cm) and minimum in G02 (2.38 cm) at the middle portion of leaf. Maximum number of leaves was found in G02 (12.67) followed by G03 (9.33) and the minimum number of leaves found in G16 (5.58). Early spike initiation was observed from germplasm G04 (56.00 days) followed by G01 (56.08 days) and late spike initiation was found from G16 (82.08 days). Maximum number of florets per spike were observed in G01 (13.42) followed by G11 (12.08) and the minimum number of florets obtained from G08 (8.00). The germplasm G12 exhibited the maximum floret diameter (10.79 cm) whereas, it was minimum in G02 (7.96 cm). Highest yield of spikes found in G10 (413.33 thousand/ha) followed by G02 (386.67 thousand/ha) and lowest yield of spikes were obtained from G01, G03, G04, G07, G08 and G09 (173.33 thousand/ha). The maximum diameter of corm (7.15 cm) and maximum individual weight of corm (141.40 g) was recorded from G01. There were also many variations in the qualitative characters of gladiolus germplasm. Sixteen different colors were obtained namely yellow (G01), orange (G02), white (G03), pink (G04), Light orange (G05), dark pink violet (G06), dark pink (G07), light pink (G08), red

(G09), red pink (G10), red pink (G11), dark red (G12), yellowish orange (G13), light yellow (G14), violet (G15) and whitish pink (G16) from the germplasms. Triangular shaped flower was found at G02, Round shape at G11 and star shaped flowers were found at germplasm G01, G03, G04, G05, G06, G07, G08, G09, G10, G12, G13, G14, G15 and G16 respectively. Flower attitude upright was found at G01, G02, G03, G04, G05, G06, G07, G08, G09, G10, G11, G12, G13, G15 and G16 respectively, whereas only one germplasm (G14) was semi- upright. Round shaped corms were observed at G03, G05, G06, G07, G08, G10, G11, G12, G13, G15 and G16, while G01 and G04 produced flattened type corm followed by 3 germplasm (G02, G09 and G14) of conical shape. The germplasm G01, G04, G09 and G16 had compact florets whereas; G02, G03, G05, G06, G07, G08, G10, G11, G12, G13, G14 and G15 had loosely linked florets on spike. It can be concluded that, the germplasm G01 for plant height, spike length and number of florets/spikes, G04 for early flowering, G10 for yield of spike, and G11 for attractive color and yield are the best of all. All the germplasm were conserved for future research.

Enhancling Yield and Quality of Banana through Improved Pre and Postharvest Practices

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Abstract

Hestudy attempted to minimize postharvest losses of banana through improved pre- and postharvest practices. To achieve the objectives, number trials were carried out at the Horticulture Farm and at the Postharvest Lab, Department of Horticulture, BAU. An experiment comprised two factors, namely postharvest treatments (control, hot water treatment at 50±5°C for 10 minutes and 5% $CaCl_2$dip for 10 minutes) and packaging (unwrapped/control, 50µ polypropylene-PP bag withor without $KMnO_4$). The longest shelf life (20.00 days) at room temperature was recorded in bananas treated with 5% $CaCl_2$ and held in 50µ PP bag with $KMnO_4$as compared to control fruit. This treatment combination also gave the best color, firmness, flavor, with reduced levels of weight loss, disease incidence and severity. In another experiment gamma irradiation and sanitizers were tested to evaluate shelf life and quality of banana. The longest shelf life of mature-green bananas was found in fruits dipped in 5% NaOCl (sodium hypochlorite) for 10 minutes followed by those soaked in H_2O_2(hydrogen peroxide). These treatments dramatically reduced postharvest diseases during the period of investigation.In a further evaluation, whole banana bunch treated with 3% H_2O_2 and held in 50 µ LDPE (low-density polyethylene) bag, and bunch held in LDPE bag containing $KMnO_4$ absorbed in vermiculite, caused remarkable extension of shelf life (12.67 and 15.33 days, respectively) of mature-green whole banana bunch at ambient temperature as compared to control (9.67 days). This treatment also resulted in negligible weight loss (0.72%) as compared to extremely high weight loss of 20.59% in untreated control at the 12^{th} day after storage. This inexpensive but safe modified atmosphere technology could be incorporated into the banana supply chain of Bangladesh to reduce postharvest quantitative and qualitative loss and for enhanced marketing.

Study on Postharvest Behaviour of Strawberry and Dragon Fruit in an Attempt to Reduce Loss and Prolong Shelf Life without Deteriorating Quality and Safety

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Abstract

Strawberry and Dragon fruit are recently introduced, nutritious, commercially profitable and non-climacteric fruits in Bangladesh. However, these fruits are highly perishable, and there ispaucity of reports related to their packaging, storage and shelf-lifeextension, especially in Bangladesh. Theobjectives of the research wereto evaluate packaging materials with or without ethylene scavenger, to examine the efficacy of hot water and irradiation, and to investigate the potential of botanical extracts on the shelf life and qualityof strawberry and Dragon fruit.A number of experiments were carried at the Postharvest Laboratory of the Department of Horticulture, BAU. The experiments

were laid out in completely randomized designs, and the parameters investigated were physiological weight loss, ripening rates (colour and firmness), TSS, disease incidence and severity, shelf life and organoleptic quality.Results showed that 25µpolypropylene (PP) bags was found suitable for packaging of Dragon fruit with prolonged shelf life at ambient condition and reduced weight loss, disease incidence and severity. Dragon fruits when treated with hot water (50±2^{o}C for 15 minutes) and held in 25µPP bags with $KMnO_4$ had prolonged shelf life with the retention of acceptable taste and quality.Results also suggested that 50µ LDPE (low density poly ethylene) bag containing ethylene scavenger ($KMnO_4$) was found to be the best packaging for Dragon fruit at ambient condition. Strawberry and Dragon fruits were gamma irradiated through ^{60}Co Cobalt source, and 1000 Gy was found effective to prolong shelf life of Dragon fruit at ambient condition (29-30 ^{o}C and 74-79% RH). Mature and well-ripen Dragon fruit had the longest shelf life when treated with hot water and coated with aloe vera gel.The above resultswould have commercial implications during postharvest handling and marketing of the highly nutritious but perishable strawberry and Dragon fruit.

Standardization of Production Technology of Colored Sweet Potato Variety and Promotion of Its Utilization to Combat Hidden Hunger

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Abstract

The study was conducted at Horticulture Farm, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during January 2021 to December 2022. This project work was carried out to determine a suitable combination of planting dates and variety and also to find out an effective combination of planting spacing variety of BAU released sweet potato. Three-experiment was conducted following randomized complete block design (RCBD) with three replications. In experiment 1, four planting dates (1st November, 15th November, 1st December and 15th December) and four BAU released sweet potato varieties (V_1: BAU Sweet Potato-1, V_2: BAU Sweet Potato-2, V_3: BAU Sweet Potato-3 and V_4: BAU Sweet Potato-4) were used. In experiment 2, four planting spacing (S_1: 60 cm x 40 cm, S_2: 60 cm x 50 cm, S_3: 90 cm x 30 cm, and S_4: 60 cm x 30 cm) and similar varieties were used. In experiment 3, similar varieties of sweet potato and four doses of organic and inorganic fertilizers (control, recommendate dose in addition withwell decomposed cowdung, andvermi composed) were used. Data on plant growth, yield contributing traits and yield of sweet potato varieties were recorded at different days after planting and after final harvesting. Results shows that different variety performed differently in terms of planting dates, and planting spacing. It was observed that the combination of P1V2 (BAU Sweet Potato-2planting on 1st November) produced the maximum number of tuberous roots per plant (7.00), fresh weight of tuberous roots per plant (970.11 g) and gross yield per hectare (51.5 tons). On the other hand, the number of tuberous roots per plant (6.93), fresh weight of tuberous roots per plant (65.0 g) and yield tuberous roots per hectare (24.2 tons) were the highest from the combinations of S_4V_2 (i.e., BAU Sweet Potato-2 with 60 cm x 30 cm planting spacing). While the lowest results (3.43, 23.22 g and 10.1 tons) were obtained from the combination of S_2V_1 (i.e., BAU Sweet Potato-1 with 60 cm x 50 cm spacing).The highest yield of tuberous roots (38.09 t/ha) was obtained from V2T3 (V2: BAU sweet potato-2 and T3: (RD+5 t/ha vermicompost) treatment combinations.In conclusion, it can be stated that among the BAU released sweet potato varieties, V_2: BAU Sweet Potato-2 would have performed superior in terms of plant growth and root yield if it is planted in 1st November using 60 cm x 30 cm planting spacing and RD+5 t/ha vermicompost fertilizer may be recommendable for cultivation of sweet potato in the Mymensingh region.

Minimal Processing of Green Coconut: A Potential Opportunity for Marketing of Coconut Water

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Abstract

Green Coconut (*Cocos nucifera* L.) popularly known as Daab (6-7 months old) is most widely useful fruit in Bangladesh. Tender/Green coconut water is a clear, colorless, slightly acidic, sweet, naturally flavored, nutritious, refreshing drink.The bulky nature of the tender coconut and its tendency to undergo biochemical changes and

spoilage after harvest are the main constraints of marketing, and it is not possible to sell this whole green fruit from the supermarkets like Agora, Shopno and many other larger supermarkets of the country. In this circumstances, the minimal processed (partial dehusk) tender coconut can be a good choice for the supermarket customers. The aim of the project was to evaluate of the postharvest water quality and shelf life of minimal processed green coconut during storage at ambient and refrigerated condition.This study was conducted at the Postgraduate Laboratory of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from January to November 2023. Freshly harvested green coconuts were collected from the Landscape section and partial dehusked (40%) and stored under five different postharvest treatments *viz.,* T1: Intact condition (control), T2:Partial dehusk green coconut (PDGC)at ambient condition ($28^0\pm2^0$C), T3:PDGCunder refrigeration (5^0C), T4:PDGC within unperforated polybag under refrigeration (5^0C), T5: PDGC within perforated polybag under refrigeration (5^0C). Water qualities of green coconut were analyzed at 2 days intervals up to 8 days after storage (DAS). There was a significant variation among the treatments in relation to maintainwater quality traits. It was observed that % TSS, %TA significantly increased while pH, ascorbic acid (Vitamin C), total sugar content declined as storage period progressed. However, mineral contents (Na, K, Ca, Mg) of green coconut water were not much changed even after 8 days of storage. Among the postharvest storage treatments, T5 (Minimal processed green coconut stored with unperforated polybag @ 5^0C) showed the excellent performance in maintaining water quality of green coconut.

Novel Approach in Promoting the Production of High Value Exotic Fruits Through Vegetative Propagation

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Abstract
Plum and Rambutan are the most important high value exotic fruits. The production of quality saplings is urgently necessary for the promotion of these exotic fruits in Bangladesh. Two-experiment were conducted at the BAU Germplasm Centre (BAU-GPC) during the period from July 2022 to June 2023to find out a suitable combination of rooting media and GA_3 concentration for the higher success and survivability of air layering of plum. And to explore a suitable grafting time for contact grafting in Rambutan. Experiment-1 was carried out following randomized complete block design with 3 replicates. Factor A includes 3 types of rooting media (M_1: 100% Garden Soil, M_2: 50% Garden soil + 50% Well Decomposed Cowdung (WDC), M_3: 50% Garden soil + 50% Vermicompost and Factor Bincludes 4 levels of GA_3 concentrations (T_1: Control, T_2: 500 ppm, T_3:1000 ppm, T_4:1500 ppm). Days to root appearance, no. of roots per layering, root length, root diameter, dry matter contents, % success and % survivability were measured during the experimental period. In experiment-2, different grafting time (April, May, June, July, August and September) was evaluated for production of true-to-type Rambutan saplings. Data were collected on days to success and survivability of contact grafting.It was found that 50% Garden soil + 50% Vermicompostshowedthe best performances in most of rooting traits. In case of GA_3, the highest concentration i.e., 1500 ppm GA_3 performed superior for most of the parameters. The combine treatment of 50% Garden soil + 50% Vermicompost with 1500 ppm GA_3 exhibited the maximum success and survivability of plum air layering. It can be recommended that 50% Garden Soil + 50% Vermicompost with 1500 ppm GA_3 treatment combination would be effective for better success and survivability of plum air layering. In experiment-2, the shortest time (10.67 days), the highest success and survivability (66.67%) were obtained from grafting operation in June followed by July and August.

Management of Stemphylium Blight of Faba Bean by Antagonistic Trichoderma spp. and Induced Resistance Chemicals

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Abstract
Stemphylium blight of Faba bean (*Vicia fabae*) is first reported at Bangladesh caused by *Stemphylium botryosum*(Acc. No. PP125801). The highest stemphylium blight incidence (63.6%) and severity (56%) were

recorded in Mymensingh than Tangail and Gazipur districts. Stemphylium blightpathogen was isolated and cultured on potato dextrose medium (PDA) which optimum radial mycelial growth was recorded from 20-25^{0}C. The conidia of *S. botryosum*are multisepted with dark brown color.The sequence of ITS region of *S. botryosum* showed 96% bootstrap value with *S. botryosum*SB12 (OQ442936) of lentil. Among the BCAs, *Trichoderma asperellum* TR1(OM480707) showed highest inhibition (81.6%) against *S. botryosum* in dual culture assay. Among the tested fungicides, Nativo, Filia and Score @1000 ppm showed100% growth inhibition against *S. botryosum*. Three spray of *T. asperellum* (OM480707) @108 cfu/ml and score @ 1000 ppm were found significantly reduced the stemphylium blight severity and increased faba bean yield than the other tested treatmentsin both net house and field experiments. The sequence of ITS region of *T. asperellum* (TR1) resulted 100% bootstrap value with *T.asperellum* UPFBK4 (OR244378) which is near to Indian isolate.*T. asperellum* (OM480707) induces to produce highest pathogenesis related proteins viz. PO, PPO, β 1,3 glucanase activity and total chlorophyll indicating it oxidisetotal phenols into Quinone which is highly toxic to pathogen and produced higher dry matter via photosynthesis. This result revealed that faba bean field sprayed with *T. asperellum* (@10^{8}cfu/ml)at 30, 45 and 60 days of intervalscould successfully manageStemphylium blightwhich effects were parallel to Score fungicide.

Molecular Characterization and Induced Systemic Resistance of Trichoderma Asperellum against Bacterial Wilt of Tomato

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Abstract

Bacterial wilt caused by *Ralstonia solanacearum* is one of the most devastating disease of tomato in Bangladesh and no significant effective control measure is available here till date. In this research work, *Trichoderma* from tomato rhizosphere is being utilized formulated with farm yard manure (FYM) to combat this pathogen attack. Ten *Ralstonia* spp. were also isolated from the infected tomato fields and characterized where *R. solancearum* isolate RsBAU1 was found most virulent, resulted about 1500 bp and 288 bp amplicon size with the 16S rDNA and species specific primers respectively. Ten (10) *Trichoderma* spp. were isolated from the tomato rhizosphere where TR3 isolate was found fast growing, very compact and dark green colony with the highest sporulation (9.67×10^7 CFU/g soil) ability on potato dextrose agar (PDA) medium. This TR3 isolate also resulted the maximum radial mycelial growth (91.0 mm) on 30^{0}C and the highest linear mycelial growth rate (32.1 mm/day) on 7.0 pH. Among 10 Trichoderma isolates, TR3 isolates (OM 480709) showed highest inhibition *in vitro* against *R. solancearum* isolate RsBAU1 that was resulted about 633 bp amplicon size with ITS primers, showed 99-100% blast homology with the other *T. asperellum*in phylogenic tree. FYM decomposed with *T. asperellum*(OM 480709) significantly reduced and delayed *Ralstonia*wilt incidence and increased tomato fruit yield including other agronomic characters under both net house and field conditions. This formulated *Trichoderma* (FT) decreased the Ralstonia wilt disease incidence by 51.5% and increased 49.73% tomato yield when compared with the pathogen-treated plot during 2022-2023. Again, FT treated plants significantly increased peroxidase (POX), phenylalanine ammonium lyase (PAL), polyphenol oxidase (PPO), β-1,3-glucanase and total phenol activities in compared to non-treated plants and these activities were increased up to 8th days when challenged with *R. solancearum* (RsBAU1) and then declined. This indicates *T. asperellum* (OM480709) might have collectively contributed to induced resistance in tomato plants against *R. solanacearum* (RsBAU1 isolate). Therefore, *T. asperellum* (OM480709) formulated in FYM can be a sustainable and eco-friendly management strategy for controlling *Ralstonia*wilt of Tomato in Bangladesh.

Trichoderma and Chemical Induced Metabolic Responses in Faba Bean for Suppression of Rust Disease in Bangladesh

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Abstract

An experiment was conducted both in *in-vitro* and *in-vivo* with three potential strains of *Trichoderma* isolates (*T. harzianum, T. viride* and *T. asperellum*) and two induced resistance chemicals (IRCs: Bion and Chitosan) during

2019-2021 cropping season to manage rust disease of faba bean. The results clearly showed that 60% culture filtrate of *T.viride;*bion and Amistar top @ 60 mM resulted 100% inhibition of uredial germination. *T. harzianum, T. asperellum* and chitosan also significantly reduced the germination of urediospores. Spraying of tricho-suspension (@10^8cfu/ml) on faba bean plants with the other IRCs significantly decreased rusty spot severity where, *T. viride* and bion were found to be the most effective treatments followed by *T. harzianum* and *T. asperellum*. All the five treatments were found significantly effective in reducing the rust disease severity of faba bean comparing with control treatment when applied under field conditions.Among the three *Trichoderma*spp.,*T.viride* showed the best performance in reducing rust disease severity (8.20% and 10.20%) followed by bion. Results also indicated that all the treatments affected significantly the agronomic parameters. Bion resulted the highest activity of POX, PPO, PAL, whereas, *T. viride*resulted the highest amount of total phenol and flavonoid. *T. harzianum*resulted the highest amount of β, 1-3 glucanase and totalchlorophyll content. The least amount of bio-chemicals with higher rust severity was recorded in case of Chitosan. Thus, the increments of POX activity, total phenols, total flavonoids and total yield revealedthat *T. viride* is a promising antagonistic species of fungi.

Characterization of Uromyces Vicia Fabae and Trichoderma Induced Metabolic Responses in Faba Bean for Suppression of Rust Disease

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Abstract

An experiment was conducted both in *in-vitro* and *in-vivo* with three potential strains of *Trichoderma* isolates (*T. harzianum, T. viride* and *T. asperellum*) and two induced resistance chemicals (IRCs: Bion and Chitosan) during 2019-2021 cropping season to manage rust disease of faba bean (*Vicia fabae*). The results clearly showed that 60% culture filtrate of *T.viride;* bion and Amistar top @ 60 mM resulted 100% inhibition of uredial germination. *T. harzianum, T. asperellum* and chitosan also significantly reduced the germination of urediospores. Spraying of tricho-suspension (@10^8cfu/ml) on faba bean plants with the other IRCs significantly decreased rusty spot severity where, *T. viride* and bion were found to be the most effective treatments followed by *T. harzianum* and *T. asperellum*. All the five treatments were found significantly effective in reducing the rust disease severity of faba bean comparing with control treatment when applied under field conditions.Among the three *Trichoderma*spp.,*T. viride* showed the best performance in reducing rust disease severity (8.20% and 10.20%) followed by bion. Results also indicated that all the treatments affected significantly the agronomic parameters. Bion resulted the highest activity of POX, PPO, PAL, whereas, *T. viride*resulted the highest amount of total phenol and flavonoid. *T. harzianum* resulted the highest amount of β, 1-3 glucanase and totalchlorophyll content. The least amount of bio-chemicals with higher rust severity was recorded in case of Chitosan. Thus, the increments of POX activity, total phenols, total flavonoids and total yield revealedthat *T. viride* is a promising antagonistic species of fungi that can be used by our farmer.

Impact of Plant Probiotic Bacteria for Mitigating Salt Stress of Rice

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Abstract

140 rhizosphere soil samples were collected from the different locations of Khulna, Satkhira, and Bagerhat districts and pH & EC (Electrical conductivity) values of the samples were determined. In total, 225 bacterial isolates were obtained from soil samples. Among them, 66 isolates were capable of phosphate solubilization and 86 isolates were capable of IAA production in culture media. Altogether, 60 bacterial isolates showed positive responses to both IAA and Phosphate solubilization assay which were initially screened by germination and seedling stands at 8 dS/m salinity. Based on the initial screening, 20 isolates showed significantly better performances considering germination % and seedling height. Selected 20 isolates were assayed for their performances in the pots maintaining artificial saline condition. Three salinity level *viz.* low, medium and high (8, 12 and 16 dS/m) were considered for evaluation

of bacterial isolates on *in-vivo* responses of rice plant. Bacterial inoculants were applied by root dipping followed by soil drenching at 15, 30 and 45 days after transplantation and salinity stress related vegetative, yield and biochemical parameters were determined. In most of the cases, vegetative, yield and biochemical parameters were significantly increased in BDISOB38KhuDu, BDISOB69KhuDu, BDISOB120KhuBa, BDISOB142KhuBa and BDISOB146KhuBa, while the proline and electrolytic leakage were significantly reduced. The lowest proline (7.65 µmoles/g fresh weight of leaves) and electrolytic leakage (60.05 %) were found in BDISOB146KhuBa under saline condition (12 dS/m). The highest relative water content and total antioxidant capacity were also increased 73 % and 125 % respectively in BDISOB146KhuBa. Moreover, a considerable yield increment was recorded in BDISOB146KhuBa followed by BDISOB38KhuDu, BDISOB69KhuDu, BDISOB120KhuBa and BDISOB142KhuBa compared to respective control. The highest BCR was also found in BDISOB146KhuBa. Therefore, this study has shown that the application of salt-tolerant plant probiotic bacteria could be an effective and sustainable solution for rice cultivation in the coastal areas.

Isolation, Characterization, and Formulation of Salt-tolerant Plant Growth-promoting Endophytic- and Rhizobacteria (PGPR) to Enhance the Productivity of Pulse Crops in the Saline-stressed Soil

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Abstract

The aims of this research were to identify halotolerant rhizobacteria and fungi from the rhizosphere of coastal regions and evaluate their ability to promote salt tolerance of mungbean. Twenty five rhizosphereic soil samples were collected from 25 different unions of four major saline prone coastal districts, *viz*., Satkhira, Borguna, Pirojpur and Bagerhat districts. The pH and electrical conductivity (EC) of the samples were measured. Total 55 bacterial and 48 fungal morphotypes were obtained. Among these, 27 bacterial and 19 fungal morphotypes were capable of producing indole-3-acetic acid (IAA) in culture media, while only 15 bacterial and seven fungal morphotypes could solubilize phosphate. Finally 13 bacterial and 6 fungal morphotypes exhibited positive responses in both IAA production and phosphate solubilization assays. Based on screening, nine bacterial morphotypes were identified, that showed superior performance in terms of seedling height and were finally selected for further experimentation. Combinations of the best performing (PGPR) and (PGPF) were also evaluated in artificial saline conditions (6, 8, and 10 dS/m) using the Binamoog-8 variety to evaluate their impact on mungbean plant responses to salinity. Application of these treatments resulted in significant improvements in growth and yield parameters and some biochemical attributes i.e., chlorophyll content, relative water content, and total antioxidant capacity, while levels of proline, malondialdehyde (MDA) & Electrolytic leakage were significantly reduced compared to the control group. Treatment T14 (*Bacillus megaterium* + *Aspergillus aculeatus*) demonstrated the best performance in enhancing salinity tolerance and showed statistically similar results to T4 (*Bacillus aquimaris*), T13 (*Bacillus megaterium* + *Aspergillus niger)* in improving mungbean plants' ability to tolerate salinity stress. In conclusion, this study suggests that the application of salt tolerant plant growth-promoting bacteria and fungi could serve as an effective and sustainable solution for enhancing mungbean cultivation in coastal areas.

Development of Strategies to Suppress Mycotoxigenic Fungi for Improvement of Post-Harvest Seed Health and Plant Growth Promotion of Maize by Exploiting Endophytic Microorganisms

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Abstract

This study was aimed to study the antagonistic effects of endophytic bacteria of maize roots and rhizosphere soil for reduction of fumonisin toxin developed by *Fusarium oxysporum*A total of 48 bacterial isolates were isolated from collected samples (root and soil). Out of the 48 bacterial isolates, 8 isolates showed highest antagonistic activity

against *F. oxysporum*. Out of 8 better performing bacterial isolates, 4 bacterial isolates (8SISO4, 8SISO5, 14SISO14, and 16SISO16) were found from the soil samples and another 4 bacterial isolates (6RISO28, 9RISO31, 9RISO32, and 11RISO33) were found from the root samples. Among the antagonists, 6RISO28 isolate showed highest mycelial growth suppression (83.95%) against *F. oxysporum*. Naturally infected maize seeds were dipped separately with eight (8) bacterial isolates maintaining different time intervals for assessing the effect of antagonistic bacteria on germination percentage, disease incidence, shoot length, root length and vigour index. Data on root length shoot length, germination percentage, disease incidence and vigor index were recorded at 1-8 months and variations were mostly observed at 8^{th} months for those features among the treated maize seeds. At the 8^{th} month of inoculation, the highest seed germination (68.67 %), shoot length (5.0 cm), root length (8.1cm), disease incidence (23.33%) were recorded in the treatment T_{23} (Maize seed dipping for 6 hr by 16SISO16 isolate) over control maize seedling. Similar trend was also recorded in the T_1 (Maize seed dipping for 1hr by 9RISO31 isolate), T_7 (Maize seed dipping for 1hr by 9RISO32 isolate) and T_{20} (Maize seed dipping for 6hr by 14SISO14 isolate) treatments but among all treatments T_{23} showed best performance to all the parameters at different intervals. Toxin concentration was measured in the best treatments along with the control. The results of toxin determination in maize seeds using ELISA test showed that the isolated antagonistic bacteria inhibited the fumonisin production. The minimum concentration was determined in T_{23} (4.5 ppm) whereas the maximum concentration was found in the control (8.8 ppm). So, 16SISO16 isolate showed highest capability to reduce fumonisin production by suppressing *F. oxysporum*.

Formulation of Microbial Bio-Pesticide from Phylloplane, Rhizospheric, and Endophytic Microbiomes of Mustard for Controlling Alternaria Blight Disease

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Abstract
Bangladesh imports huge amount of edible oil every year. The govt. of Bangladesh emphasizes to reduce the dependency for edible oil import and encourages the increase of internal oil crop production. Mustard is the leading oilseed crop in Bangladesh. However, a number of biological barriers impede its production, where the most serious one is alternaria leaf blight caused by *Alternaria* sp. that can limit the yield up to 70.0%. The present study was intended to determine the efficacy of the native rhizospheres', endophytic, and phylloplane microbes of mustard plant to manage alternaria leaf blight. Twenty six mustard plant samples with root-adhered soil were collected from 11 upazilas under 6 districts of Bangladesh. A comprehensive *in-vitro* antagonistic assay of endophytic, rhizosperic and phylloplane microbes against *Alternaria* sp. reveals that all rhizospheric, endophytic and phylloplane microorganisms can substantially suppress the mycelia growth. Among all the antagonists rhizospheric (RF15A), endophytic (BAUEF 9A) and phylloplane (PF9A) performs better showing 79.54, 86.05, and 88.89% suppression compare to control. The performances of the antagonists were further evaluated in the pot experiments under artificial inoculated condition where RF 15A, BAUEF 9A and PF9A showed significantly better responses in yield contributing traits like number of pods, pod length, grain per pods and weight of grains, pod infection , yield per pot with the lowest disease severity 26.11, 25.79 and 25.74 % respectively. In conclusion, using antagonistic microbes from the rhizosphere, endosphere, and phyllosphere may be a sustainable alternative for controlling alternaria leaf blight of mustard.

Identification of Atoxigenic *Aspergillus flavus* in Controlling Aflatoxins Contamination in Maize

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Abstract
Aflatoxins are fungal metabolites produced by several *Aspergillus*species and possess acute life-threatening toxicity due to their carcinogenic properties. Aflatoxins are mainly hepatocarcinogenic toxins comprising of major three

metabolitesAflatoxinB, M and G. *The toxicity level of aflatoxins of different types chronologically are B1>G1>B2>G2.* Several approaches have been practiced to mitigate aflatoxin contamination, however, none of the approaches provide a long-term solution. Therefore, the present study was carried out to identify the atoxigenic*A. flavus*isolates and to evaluate their efficacy in limiting aflatoxin contamination in *in vitro* and *in planta*cob. A total of 44 *A. flavus*isolates were isolated and identified by morphological characteristics and by sequencing of ITS region. Atoxigenicity was confirmed by the amplification of *nor1*, *aflR*and *omtA*genes of aflatoxin biosynthesis gene cluster. In *in vitro* assessment, 38 isolates were significantly ($p<0.01$) diminished aflatoxin accumulation varying from 7 to 92% in inoculated maize grains. Conversely, 6 isolates increased aflatoxin accumulation ranging from 2.73% to 49.16% compared to uninoculated maize grain. However, isolates AF72, AF73, AF76 increased aflatoxin accumulation even they were confirmed as atoxigenic; on the other hand, isolates AF153, AF11, AF13, AF191 and AF90 were able to diminish aflatoxin accumulation although they were confirmed as toxigenic. Assessment of atoxigenic*A. flavus*isolates in *in planta*cob inoculation conceded that all isolates reduced aflatoxin accumulation ($p<0.01$) by 80% to 90% compared to uninoculated maize except the isolate AF01 and AF165. Furthermore, isolate AF72 and AF73 surged aflatoxin accumulation in *in vitro* but they were able to diminished aflatoxin in *in planta*assessment. Research focusing Cluster Amplification Patterns (CAPs) analysis and Simple Sequence Repeat (SSR) genotyping of these *A. flavus* isolates to confirm the deletion of aflatoxin biosynthesis genesare ongoing for developing biocontrol product (s) for controlling aflatoxin contamination in maize.

Development of Nutrient Based Innovative Technology for Improved Management of Citrus Greening Disease of Sweet Orange

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Abstract

Citrus greening caused by *Candidatus* Liberibacter asiaticus (*C*Las) poses a great threat to the growing citrus industry. In this study, the effects of some selected nutrient elements were assessed in managing citrus greening of sweet orange. The results revealed that all of the treatments showed positive effects in reducing citrus greening severity by (36-72%) over control in 2022 (trees received improved nutrient management (INM) compared to 2021 (trees without INM). The minimum rate of increase of citrus greening severity was recorded when sweet orange trees were treated with T_4 (SCF + foliar spray of Boron), T_{10} (SCF + soil plus foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe) and T_6 (SCF + foliar spray of Hamoxy) compared to untreated trees. However, the maximum reduction rate of *C*las bacterial titer was estimated by qRT-PCR in trees that received treatment T_{10}, T_1 (SCF + foliar spray of Hay Cal) and T_{11} (SCF + soil plus foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe + Bismerthiazo) + Spray of Guava leaf extract + Oxytetracycline as compared to control. The results of nutrient management experiments clearly showed that uptake of all nutrient elements by sweet orange trees was higher as compared to untreated trees. The fruit yield and quality were also improved when trees treated with T_{10} followed by T_{12}, T_{13} (SCF + soil plus foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe + beta-amino butyric acid (BABA) + 3 Ascorbic acid (AA) + Salicylic acid (SA) + compost). The results also revealed that maximum vitamin C and soluble sugar were estimated in sweet orange juice when trees were fertilized with above macro- and micro-nutrients. The present study indicated that nutrient management enhanced fruit yield and quality of sweet oranges by minimizing citrus greening severity.

Assessing Biocontrol Efficacy of Atoxigenic *Aspergillus flavus* Strains Against Aflatoxins Contamination in Maize Produced in Bangladesh

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Abstract

Maize is an important growing cereal for its multifarious usesas food and feed. Aflatoxins are a group of toxic and carcinogenic secondary metabolites produced primarily by members of the *Aspergillus* section *Flavi*. The major

classes of aflatoxins include B_1, B_2, G_1, and G_2 of which AFB_1 is the most toxic produced by typically strains of *A. flavus.* Risk assessment is mandatory for pre-harvest mitigation of aflatoxin contamination in maize using the atoxigenic*Aspergillusflavus* strains.A total of 110 pre-harvest maize grain samples were collected of which 60 in early season and 50 in late season. Green Spring Total and B1 aflatoxin detection kits were used to quantify the severity of the total and B1 aflatoxins contamination in pre-harvest maize. The results revealed that the significantly maximum total aflatoxins (71.51ppb) was quantified in Kustia followed by Meherpur (45.88ppb) while the minimum (1.56ppb) was quantified in Rajshahi. Two maize kernel samples collected from Kustia and Meherpurhad greater contamination of total aflaotxinswhich exceeded the regulatory limit for total aflatoxins in corn set by both EU (10ppb) and USA (20ppb) in early season. One the other hand, significantly maximum (32.52ppb) total aflatoxin was determined in samples collected from Panchagarh while the minimum (2.15ppb) in samples obtained from Natore. The results showed that higher contamination of total aflaotxins was determined in only one sample collected from Panchagarh exceeding the regulatory limit of EU (10ppb) and USA (20ppb). The maximum (318ppb) total afaltoxin contamination was determined in one samples collected from Kustia followed by Meherpur (45.87ppb) and Panchagarh (32.52ppb) exceeding the limits set by both EU and US in early season. Two samples from Kustia, two from Meherpur and two from Panchagarh had higher contamination of aflatoxin B1 exceeded the EU regulatory limit (5ppb) for B1 in corn.

Impact of Climatic Factors on the Seasonal Fluctuations of Aflatoxin Contamination in Maize for Ensuring Better Management and Safe Food in Bangladesh

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Abstract

Maize (Zea mays) is an important emerging cereal and is susceptible to contamination with aflatoxins that are produced by *Aspergillusflavus* and *A.parasiticus*. Aflatoxinshazard to public health due to their toxicity and carcinogenicity. Experiments were conducted to assess the seasonal variation of aflatoxin contamination in selected maize hybrids viz. NH7220, DON-111, Averest, PAC-339, PAC-984, Kaveri-50 and BOSS in Sutiakhali, Mymensingh during early, mid and late season of 2022-2023, to find out the relationship between aflatoxin contamination and climate variables and to identify the toxigenic *A. flavus*. The result of aflatoxin concentration was determined by Enzyme-linked immusorbent assay (ELISA) using AgraQuant total aflatoxin detection kit. The results showed that the lowest amount of aflatoxin contamination was observed in late season than early and mid-season in all maize varieties. In early season the highest (36.77ppb) aflatoxin concentration was quantified in Kaveri-50 and the lowest (11.07ppb) aflatoxin concentration was determined in PAC-984. In late season the highest (5.56ppb) aflatoxin concentration was determined in DON-111 and the lowest (3.16ppb) aflatoxin concentration was quantified in PAC-984. The variety PAC-984 variety exhibited the lowest aflatoxin concentration in both of the seasons. Season wise regression analysis was performed between each climate variable and aflatoxin concentration. Regression analysis revealed significant positive relation between aflatoxin concentration and temperature where aflatoxin concentration increases with the increase of temperature. However, with the increase of rainfall and relative humidity, the concentration of aflatoxin reduces which depicts significant negative correlation between them. A total of 22% (eight out of 35) toxigenic *A. flavus* and 78% (27 out of 35) were identified from maize grains obtained from different varieties studied by using primers specific to *nor*, *omtA* and *apa*2. These results will serve as benchmark for monitoring aflatoxin contamination in maize hybrids to identify the resistant/tolerant for producing safe food and feed.

Development of Mustard Based Biofumigation as an Innovative Alternative to Chemical Fumigants for Bacterial Wilt Management in Brinjal

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Abstract
Bacterial wilt (BW) caused by *Ralstoniasolanacearum* emerged as a new challenge for growing Btbrinjal. The potential of dried powdered mustard (*Brassica juncea*) plant biomass to control BW of eggplant in both net house and field conditions were studied. Dried mustard plant biomass was applied as mixed with the soil. The soils were artificially inoculated with *R. solanacearum* @ of *R. solanacearum* [(10^8 CFU/ml) per kg of soil)] at 0, 10, and 20 days before transplanting (DBT). Aqueous extract of dried mustard biomass (36% w/v) was found to be effective compared to rest of aqueous extracts (12% and 24% w/v) in inhibiting the *in vitro* growth of *R. solanacearum* in liquid culture. The results of net house experiment demonstrated that the higher dried mustard plant biomass (@ 36 g/kg of soil) mixed with inoculated soil at 10 DBT, was found most effective in controlling BW compared to 0 and 20 DBT. This dose also increased root length (cm), shoot length (cm), and plant fresh biomass (g) over control plants. A reduction of 60% of area under disease progress curve (AUDPC) over control was observed at 10 DBT when plants were grown in soils amended with dried mustard plant biomass. The results of lab experiments also revealed significant reduction of *R. solanacearum* population in broth amended with aqueous extracts of dried mustard plant biomass and in amended soils through decreasing soil pH.The dried mustard biomass(1.8 and 2.4 tons/ha) which are equivalent to 24 and 36 g dried mustard plant biomass per kg of soil at 10 DBT were found most successful in suppressing BW incidence by 50% compared to control. The results indicated that the soil amendment with dried mustard plant biomass thoroughly mixed with soil at 10 DBT, could act as an effective control method against BW.

Detection of Bacterial Blight Resistant Gene(S) in Some Indigenous, Advanced Lines and Cultivated Rice Varieties Using Gene Based Molecular Markers

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Abstract
Among the rice diseases, bacterial blight (BB) caused by *Xanthomonasoryzae*pv.*oryzae*(Xoo) is one of the oldest and most devastating diseases in Bangladesh. But tillnow there is no effective highly resistant variety developed against this disease inBangladesh. Owing to that, molecular-phenotypic screening and allelic diversity of 5major BB resistant genes (Xa4, xa5, xa13, Xa21, and Xa23) were determined in 85 ricegenotypes with 5 previously synthesized gene based molecular markers (MP1-2,RM122, Xa13Prom, pTA248, and 03STS1) at Plant Pathology Department,Bangladesh Agricultural University and Plant Pathology Division, Bangladesh Instituteof Nuclear Agriculture, Mymensingh from June 2022 to August 2023. Out of 85 studiedrice genotypes, 54 were identified as carriers of the Xa4 gene, while 25 genotypes possessed the xa5 gene. Notably, only 1 genotype each was found to contain thexa13, Xa21, and Xa23 genes along with other genes, indicating their rarity within thesample. The genetic frequencies of 5 BB resistant genes ranged from 1.18% to 63.53%among the studied population. The resistant gene Xa4 was widely distributed (63.53%)among the selected genotypes followed by xa5. Ten Xoo isolates were developed frominfected rice leaves and confirmed with species-specific molecular marker in this study.Out of 10 Xoo isolates, 2 were identified as highly virulent isolates based on populationgrowth analysis through optical density measurement and pathogenicity test in order toassess the resistance performance of inoculated rice genotypes having one or fewresistant gene(s). Based on the phenotypic resistance screening, 2 genotypes wereshown as highly resistant, while 13 genotypes were resistant, 11 genotypes weremoderately resistant, 5 genotypes were moderately susceptible and 30 genotypes weresusceptible. It was observed that 28 genotypes with the Xa4 gene alone displayedsusceptibility when exposed to Xoo. Only five genotypes contained the xa5

geneindividually, and their phenotypic responses varied from susceptible to moderatelyresistant. Genotypes possessing the xa13, Xa21, or Xa23 genes were not identifiedindividually among the studied population. However, these resistant genes were foundin various combinations among the studied genotypes. When combinations of two orthree genes (Xa4+xa5; Xa4+Xa21; Xa4+xa5+xa13; Xa4+xa5+Xa23) were present inthe genotypes, lesion lengths were reduced, indicating the efficacy of these genecombinations. Notably, the Xa4+xa5 combination was found in 23 genotypes withmoderately resistance to resistance phenotypic responses, while Xa4+Xa21 was foundin 1 cultivated variety (BRRI Dhan-101) exhibiting resistance reaction. TheXa4+xa5+xa13 gene combination was found in 1 advanced line (BLB-P-003) displayinghighly resistance, and the Xa4+xa5+Xa23 gene combination was found in 1 localcultivar (Sete Pajam-2) also showing highly resistance reaction. Combining two or moreBB resistant genes was more effective in providing resistance against Xoo compared toa single resistant gene found in this study. The study using the area under diseaseprogress curve (AUDPC) method demonstrated a rapid progression of BB disease inthe studied rice genotypes with resistant genes over 21 days, with symptomsappearing in 28.92% of plants by 7 days after inoculation (DAI), nearly half (48.37%)affected by 14 DAI, and over 50% affected by 21 DAI, showing an initial rapid spreadfollowed by a slower rate of progression. It can be concluded that advanced line BLB-P-003 and indigenous cultivar Sete Pajam-2 will be promising candidates fordeveloping the resistant variety against BB disease of rice in Bangladesh. In addition,the AUDPC result indicates that control measures should be taken as soon as diseasesymptoms appear in the field.

Analysis of Morphological Variation of *Pyriculariaoryzae* Causing Rice Blast Disease in Haor Areas of Bangladesh and Its Bio-Control with Plant Growth Promotingendophytic Bacteria

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Abstract

The production of rice is significantly hampered by blast disease in Bangladesh including haor areas. Due to that, this study was conducted to know the morpho-molecular variation of rice blast pathogen in haor areas of Bangladesh and to find out the effect of plant growth promoting rhizobacteria (PGPR) in controlling rice blast disease. This research work was performed at the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh from July 2020 to June 2023. In this research work, infected samples with rice blast symptoms were collected from different haor regions and identified both morphological and molecular markers. Twenty *M. oryzae*isolates were differentiated morphologically based on their colony morphology, conidial shape and size, degree of sporulation (no. conidia/ml), colony growth rate among the *M. oryzae* isolates and colony growth rate compared to other fungal isolates. For the bio-control of rice blast, 105 bacterial isolates were isolated from the rice endophytic areasand 30 bacterial isolates out of 105 showed moderate to strong antagonistic activity (66.52% to 91.00% growth inhibition) *to M. oryzae.* Plant growth-promoting activities of those 30 antagonistic rhizobacterial isolates were observed with the production of Indole Acetic Acid (IAA), phosphate solubilization test, siderophore and HCN production.The growth promotion of rice plants was also assessed using 30 bacterial isolates in this study by the determination of germination percentage, root length, shoot length and vigor index in treated and control plants. Eight PGPR isolates having growth inhibition ability against rice blast pathogen, five were identified by 16S rDNA gene sequence analysis and all the identified bacterial isolates belonged to three different genera such as *Bacillus, Pseudomonas* and *Serratia*. Among the antagonistic PGPR isolates, BDPMIL-06, and BDPMIL-38 were different species of *Pseudomonas*, BDPMIL-04 and BDPMIL-52 were *Bacillus* and BDPMIL-55 was from *Serratia*genera. The phylogenetic tree analysis of the isolates based on the nucleotide bases of 16S rDNA revealed that all 5 bacterial isolates were distributed in two main groups (PGPR BDPMIL-52, BDPMIL-55 and BDPMIL-38 were in the group- I and PGPR BDPMIL-04 and BDPMIL-06 were present in the group –II). In this study, 10 rendophyticbacterial isolates which have a strong antagonistic activity to *M. oryzae* causing rice blast were used as formulated product to control rice blast in the net house condition. BDPMIL-46 isolates significantly reduced blast incidence and severity compared to other bacterial-bioagents and control. The current study may open the way for future research on management of rice blast in the haor areas of Bangladesh using plant growth promoting endophytic bacteria.

Elucidate the Effect of Plant Growth Promoting Rhizobacteria on Drought Responses of Rice

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Abstract
Drought, a long period with no rain or unusually low levels of rain or other precipitation is one of the most significant abiotic stress factors causing the reduction of growth and yield of rice cultivated in drought-prone regions of Bangladesh. Owing to that, this study aimed to evaluate the effect of some plant growth promoting rhizobacteria (PGPR) in drought response of two rice varieties (Drought tolerant BRRI dhan71 and drought susceptible IR 64) by observing morphological and yield parameters under different drought stress conditions. This study was conducted at the Plant Microbe Interaction Laboratory, Department of Plant Pathology and Professor Golam Ali Fakir Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh-2202. In this study, around 100 rhizobacterial isolates were collected from the rice rhizosphere of eight drought prone districts (Naogoan, Rajshahi, Chuadanga, Jessore, Chapainawabgong, Kustia, Shatkhira and Rangpur) and the antagonistic performance of those bacterial isolates was observed in *in vitro* condition by the dual culture triangular method against *Rhizoctoniasolani and Xanthomonasoryzae*pv.*oryzae (Xoo)*causing sheath blight and bacterial blight disease of rice respectively.Among the 100 rhizobacterial isolates, 30 isolates showed moderate to strong antagonistic activity against *R. solani*and*Xoo*. Nine (9) isolates out of 30 rhizobacterial isolates showed strong antagonistic activity to *R. solani* (80.00% to 84.62% growth inhibition) and 8 isolates showed moderate to strong antagonistic activity to *Xoo*(70.49% to 82.94% growth inhibition). Plant growth-promoting activities of those 30 antagonistic rhizobacterial isolates were observed with the production of Indole Acetic Acid (IAA), phosphate solubilization test, siderophore and HCN production. Out of the 30 rhizobacterial isolates, 12 isolates were found to produce IAA, 9 isolates showed the capability of phosphate solubilization, 17 produced siderophore and 21 isolates showed the capability of producing hydrogen cyanide. The growth promotion of rice plants was also assessed using 30 rhizobacterial isolates in this study by the determination of germination percentage, root length, shoot length and vigor index in treated and control plants. Ten rhizobacterial isolates can boost root growth, shoot growth and vigor index compared to the control. Following the dual culture assay, eight antagonistic PGPR isolates were found to exhibit moderate to strong antagonistic behavior against two rice pathogens (approximately 70.49% to 84.62%). Out of eight PGPR isolates having higher growth inhibition ability against two pathogens, five were identified by 16S rDNA gene sequence analysis and all the identified bacterial isolates belonged to three different genera such as *Bacillus, Pseudomonas* and *Serratia*.Among the 30 isolates, five isolates significantly reduced drought effect both for drought susceptible and tolerant rice varieties.

Biofortification of Mungbean (*Vigna Radiata*) Grain with Zinc for Improved Nutrition to Malnourished People of Bangladesh

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Abstract
Mungbean [*Vigna radiata* L. (Wilczek)] is considered as an extremely nutritious crop possessing a high level of micronutrients, but their low bioavailability in the crop leads to micronutrient malnutrition in humans. Zn deficiency is not only the major constraint of lower yield, but also dietary Zn deficiency in cereals may cause increasing malnutrition and chronic health problems in human. Exogenous application of Zn through basal and foliar application might be a useful option to recover Zn deficiency. Therefore an experiment was conducted in the Field Laboratory of the Department o Crop Botany, BAU to evaluate the Zn fertlization treatments viz. nil Zn (i.e. control), soil Zn application (5.0 kg Zn ha^{-1}), foliar Zn application (1% aqueous Zn solution that sprayed at 35 & 50 DAS), and soil Zn+foliar Zn (combination of previous 2 treatments) on the growth and yield, and grain Zn content of two varieties of mungbean e.g. BARI Mug-5 and BARI Mug-6. The source of Zn was white vitriol (ZnSO4·7H2O). The experiment was conducted during the *Kharif-I* season following the Randomized Complete Block Design with three replications. Data were collected on plant height, number of primary branches/plant, yield

components, yield and Zn content of mungbean grain. Plant height, pod length, number of pod per plant and grain per pod, 1000-grain weight and grain yield, grain Zn content significantly (*P<0.01*) increased when the crops fertilized soil Zn and foliar Zn, while their combination effects showed better performance. As compared to no Zn apply, the crops grown with soil Zn application and combine Zn application in soil and foliage enhanced the grain yield by 18 and 25%, and grain zinc content by 13 and 33% (varieties mean). Foliar Zn application was found more effective (almost double) for grain zinc biofortification than that from soil Zn application.

Estimation of Potential Gaps to Climate-Smart Agricultural Practices in Vulnerable Coastal Region of Bangladesh

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Abstract

Coastal areas in southern Bangladesh experiences at lot of climate change threats that may lead to loss of agricultural production and food insecurity. Although many climate-smart technologies are recommended for the region but the achievement is still far from the goal. Therefore the aim of the study is to find out the potential barriers and gaps for adopting the climate-smart agricultural (CSA) practices for food security there. The study used the mix mode methods that cover the collection of both primary and secondary data. Primary data include the qualitative information collected through focus group discussion with climate-stressed farmers and consulting official stakeholders working in the areas. A semi-structured questionnaire was used for collecting quantitative primary data from the coastal farmers. Secondary data collected from literature include the CSA practices that would enhance the production in the study areas. More than fifty befitted practices in the coastal areas are identified or so far recommended for strengthening the CSA-pillars like productivity, adaptation and mitigation in favour of food security and sustainable development. However, distinct variation are ferreted out between the recommended technologies and observed ones that currently being practiced by the coastal farmers. Data on farmer's climate change perception and delivery of agro-met and agro-advisory information from service providers to farmers are collected, and observed unequivocal gaps that seek necessary attention.

Effect of Seed Priming on Zinc Biofortification in Mungbean Grain

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Abstract

Among the micronutrients, zinc (Zn) is one of the most vital nutrients required for the growth and development of human and plants. Cereal based crop cultivation and human diets are the major cause of Zn malnutrition worldwide including Bangladesh. A research was conducted during *Kharif-I* season of 2023 in the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensinghto optimize Zn seed priming treatments for improving the plant growth, grain yield and grain biofortification of four varieties mungbean (*Vignaradiata* (L.) Wilczek) viz. BARI Mug-2, BARI Mug-3, BARI Mug-4 and BINA Mug-8.Mungbean seeds were soaked in water (hydropriming), or aerated solution of containing 0.01 or 0.05M Zn. The results showed that seed priming at 0.01M Zn solution improved the morphological development like plant height and primary branch number, yield parameters, grain yield and seed Zn concentrations of mungbean. Seed priming with water and 0.01M Zn solution increased the grain yield by 12.3 and 5.8% and grain Zn concentrations by 12.2 and 8.2%, respectively than the crop grown with non-primed seeds. Although Zn enrichment in mungbean grain was observed with 0.05M Zn as a seed priming treatment, but the performance was not proved as better than the 0.01M Zn solution. Additionally plant growth and yield traits, grain yield were significantly reduced when the seeds were subjected to priming with 0.05M Zn. In conclusion, mungbeanseeds might be primed with 0.01M Zn solution to have better stand establishment, and yield parameters, grain yield and grain Zn concentrations of mungbean.

Foliar Application of Abscisic Acid and Glycine Betaine Triggers Drought Tolerance Modulating Physiology, Yield and Antioxidative Defense Systemin Wheat

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Abstract
Global climate model predicts frequent and severe drought in the future resulting in limited crop production affecting growth and yield. The extent of drought tolerance in two wheat cultivars (WMRI-1 and BARI GOM-33) was investigated by foliar application of abscisic acid (ABA) and glycine betaine (GB) at the anthesis and grain filling stages. A pot experiment maintaining completely randomized design with four replications was set in the field laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, Bangladesh. A total of four treatments were followed such as i) Control(20-22% moisture content) ii) Drought (8-10% moisture content)iii) Drought + ABA and iv) Drought + GB.The plants at the reproductive stage were sprayedweekly with ABA (20 µM) and GB (50 mM) under drought conditions. Drought stress significantly declined chlorophyll content and photosynthetic rate in comparison to control. However, the foliar application of ABA and GB under drought considerably increased the rate of photosynthesis and pigment contents in the flag leaves compared to the plants grown under individual drought conditions. A considerable increase in lipid peroxidation and H_2O_2 contents in flag leaves were recorded in all drought conditions, while these values were reduced in ABA and GB treatments. ABA and GB application significantly enhanced the catalase and peroxidase enzymes activities and total antioxidant capacity exhibiting reduction in oxidative damage and increased grain yield. Heatmap using stress tolerance index (STI) showed that Drought+ABA and Drought+GB secured higher STI scores suggesting a greater degree of drought tolerance in both cultivars. In conclusion, foliar spraying of ABA and GB enhanced drought tolerance in both wheatcultivars by altering physiology and antioxidative defense suggesting a declined state of oxidative damage with increased yield.

Use of Anatomical Traits for Characterizing Linseed Genotypes Available in Bangladesh

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Abstract
Multipurpose linseed / flax is a well-known oilseed and the third-largest natural fibre yielding crop in the world. The flax type (fibre purpose) cultivars are generally slender, tall and slightly branched whereas, linseed type (seed purpose) are shorter and much-branched.Although we have only one recommended cultivar of flax cv. *Neela* for seed purpose only from Bangladesh Agricultural Research Institute, there are some local genotypes which may have potential uses. Improvement of product quality and productivity can be gained through better understanding of the material structure. To increase the fibre yield and identify superior genotypes for fibre production it is very important to know in detail the ultrastructure of the fibre bearing stem tissues. This experiment was designed to understand the stem anatomical differences that make one variety a fibre type and the other an oilseed type. Stem cross-sections of ten (10) genotypes were observed and analyzed using Carl Zeiss Axioskop 40 optical microscope with 10x magnification. In total 10 anatomical traits *viz.* epidermis width (µm), cortex width (µm), cambial zone width (µm), average area of individual fibre cells (μm^2), number of fibre cells in the stem, total fibre area in the stem (μm^2), stem area (μm^2), pith area (μm^2), xylem area (μm^2) and phloem area (μm^2) were used to screen the genotypes. Results revealed that high fibre genotypes (*viz.*BD-7145, BARI Tishi-1, Canada & Tangail) were seen to have more stem area, total fibre area in the stem and fibre to stem ratio as compared to the low fibre lines/ oilseed types. Correlation studies have shown that fibre concentration is closely related to traits like number of fibre cells and total area of fibre present in the stem indicating the importance of these anatomical traits in selecting genotypes with improved fibre content.

Application of Zinc and Silicon Fertilizer: Influences Yield and Nutritional Quality of Purple Rice in Rice (T Aman) – Rice (Boro) Cropping Pattern

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Abstract

The micronutrients are equally important as macronutrients although they are required in a minute quantity. Zinc (Zn) and silicon (Si) are important micronutrients for the healthy and competitive growth and yield of all cereals including rice in Asia. To explore the effect of Zn and Si on the yield and nutritional status of Purple rice, a two-factorial experiment with three rice cultivars, *viz*. Purple rice, Pahari rice, and a check cultivar, and four fertilizer treatments, *viz*. T_0- Control (recommended dose of fertilizers; RDF), T_1- RDF + 6 kg ha^{-1} $ZnSO_4$, T_2- RDF + 40 kg ha^{-1} $CaSiO_3$, and T_3- RDF + 60 kg ha^{-1} $CaSiO_3$ was conducted following split-plot design with three replications at the T. Aman season and Boro season of the first year (2021-22). The experiment was repeated in the next year (2022-23) with some changes in fertilizer combinations and application methods. Results revealed that the application of zinc and silicon significantly influenced the growth and yield of rice. Plant height, flag leaf length and width, and panicle length were recorded maximum with the application of T_0 and T_3 fertilizer doses. The number of primary and secondary branches per panicle and filled grains (no.) per panicle were found to be maximum with the application of T_1 and T_3 fertilizer doses. Thousand seed weight was recorded maximum with the application of T_1; although the grain yield did not affect significantly. The grain yield followed the trend Binadhan-7>Pahari rice>Purple rice in T Aman season and BRRI dhan28>Purple rice>Pahari rice in Boro season. The nutritional quality of rice grains varied on fertilizer management and cropping seasons. The application of Zn (@6 kg ha^{-1} $ZnSO_4$) significantly improved the Fe content in grains of Purple and Pahari rice and the application of silicon (@60 kg ha^{-1} $CaSiO_3$) improved the Zn concentration in grains of BRRI dhan28. The nutritional quality (both Zn and Fe contents) of grains was better in the Boro season compared to those of the T. Aman season.

Boosting Immunity, Growth and Yield of Tomato by Applying Biogenic Copper Nano-Fertilizer

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Abstract

The global food security challenge is that a projected 60% increase in food production by 2050 will be needed compared to today. Therefore, novel approaches that are eco-friendly and sustainable are necessary for both plants and humans. Traditional fertilizers are costly, harmful to the environmental whereas nano-version of them are less expensive, efficient and eco-friendly. Among the coinage metal nanoparticles (NPs), CuNPs are of great interest due to low cost, easily available and high electrical conductivity. **Why Cu is chosen?** Interestingly, Cu is itself three in one. It is used as fungicides (**Bordeaux mixture**), immune booster (**elicitor**) and fertilizer (**micronutrient**). For over a decade, nanomaterials have played a distinct role in the agricultural sector. They have the potential to minimize chemical usage. The aim of the current investigation was to produce a sustainable source of copper nanoparticles (CuNPs) by utilizing the plant's extract. It is because of physical, chemical and microbiological methods for synthesizing NPs are expensive, high energy investment and environmental unfriendly whereas phytofabricated CuNPs cheap, facile, eco-friendly, reproducible and socially acceptable. The biogenic CuNPs were characterized by UV-vis, FTIR, XRD and SEM. UV-visible spectra show a broad peak at 320 nm, along with varied reaction conditions. Treatment with various concentrations of CuNPs showed an increasing trend in photosynthetic pigments, phenolic content and antioxidant properties. In fact, biogenic CuNPs significantly modified the phenolic content which triggers cell wall liginification and boosting immunity as well.

Phytochemical Properties of Certain Aromatic Lamiaceae Species are Influenced Differently by Mild Drought and Salinity Stress

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Abstract

The response of plants to salt and drought stress is quite similar as both lead to reduced yield due to decreased water potential. However, in some cases, mild drought and salinity may not always significantly decrease plant masses, and they might even promote plant development. This research examined how mild drought and salinity affect plant growth. An experiment was conducted using a two-factor completely randomized design with a total of 18 treatment combinations (6 plant species × 3 stress factors). A total of 72 pots (18 × 4 replicates) were placed in the pothouse of the Department of Crop Botany, BAU. Six different species from the Lamiaceae family, including *Ocimum basilicum* var. *thyrsiflora*, *Hyptis suaveolens* (L.), *Ocimum tenuiflorum*, *Ocimum americanum*, and two morphotypes of *Ocimum basilicum* (L.), were grown. Mild salinity (EC 4 dS m^{-1}) was induced with NaCl at day 30 for the salt treatment, while control and moderate drought conditions were maintained at 60% and 90% of field capacity, respectively. Plants were harvested after three months of growth for all treatments. The fresh shoot masses of the six Lamiaceae species ranged from 21.5 to 71.6 g $plant^{-1}$, 12.3 to 57.1 g $plant^{-1}$, and 11.60 to 131.4 g $plant^{-1}$ under control, drought, and salinity conditions, respectively. Drought caused an increase in phenolics by 34.7% in sweet basil-2. Flavonoids were increased in Rama tulsi, Thai basil, sweet basil-1 and sweet basil-2 due to drought. FRAP assay showed an increase in antioxidant activity in Thai basil, sweet basil-1 and sweet basil-2under salinity. DPPH assay confirms the higher free radical detoxification potential of Thai basil and sweet basil-1 under salinity.

Phytochemical Characteristics and the Potential for Detoxifying Free Radicals in the Leaf Gel of Some Distinct Aloe Species

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Abstract

Aloe, belonging to the Liliaceae family, resembles a cactus with its green, dagger-shaped leaves that are fleshy, tapering, spiny, marginated, and containing a clear viscous gel. An experiment was carried out using a completely randomized design involving five distinct species of Aloe: *Aloe burgersfortensis, A. caesis, A. brevifolia, A. hereroensis, and A. jucanda*, all of which were maintained in the pot-house of the Bangladesh Agricultural University Botanical Garden. Across these five *Aloe* species, shoot lengths ranged from 45.3 to 89.8 cm, and root lengths ranged from 11.5 to 21.6 cm. The number of leaves varied from 16 to 32, while the average leaf length and thickness ranged between 11.45 to 48.87 cm and 0.22 to 1.48 cm, respectively. The gel content ranged from 31.5 to 62.2% among the five genotypes. The amount of flavonoids and phenolics, ferric reducing antioxidative power (FRAP), and DPPH free radical detoxification potential varied to a different extent among the five studied *Aloe* species.

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Biological Nitrification Inhibition (BNI) Potential of Sorghum Root Exudates for Enhancing Nitrogen Use Efficiency in Rice Production System

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Abstract

The irrational use of nitrogenous fertilizers in agricultural systems has generated a negative impact on the environment since around 70% of these fertilizers are lost due to nitrification and associated processes. Regulation of nitrification could be a key strategy to improve N-recovery and agronomic nitrogen use efficiency of crops. The studies were made with the emphasis to investigate the impacts of sorghum root exudates for exploiting the biological nitrification inhibition (BNI) function to slow down the soil nitrification process to improve the nitrogen use efficiency in rice cropping system. To accomplish these purposes, two experiments were conducted in the Field Laboratory of Department of Crop Botany, Bangladesh Agricultural University, Mymensingh both in pot culture and field conditions.Rice (BRRI dhan28) were grown in the *boro* season following the standard means of cultural operations. Root exudates of hydroponically grown sorghum were collected and applied during the three splits of urea application in rice. Therefore, five following treatments viz., T_0= No root exudates + No urea; T_1= Sorghum root exudates + 137.5 Kg Urea ha^{-1} (55% RD); T_2= Sorghum root exudates + 175 Kg Urea ha^{-1} (70% RD); T_3= Sorghum root exudates + 212.5 Kg Urea ha^{-1} (85% RD); T_4= 250 Kg Urea ha^{-1} (recommended dose, RD)were employedin a single-factor CRD design.In both pot and field experiment, the novel natural nitrification inhibitors from sorghum root exudates enhanced the nitrogen use efficiency by improving yield and yield contributing characters of rice. The results also manifested that urea applied with reduced doses along biological nitrification inhibitors exhibited more apparent recovery efficiency than urea added alone and maintained statistically similar grain yield of rice. It can be concluded that sorghum root exudateshave the enormous potentiality to increase nitrogen use efficiency in rice cropping system.

Boron-Mediated Amelioration of Aluminium Toxicity Involved Aluminium Tolerance in Sunflower

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Abstract

Soil acidity problem becomes acute and thousands of hectare land remains fallow in Acid Basin Clays, Acid Sulphate Soils and Brown Hill Soils. Aluminum (Al) toxicity is a major limiting factor for crop development and productivity in acid soils due to loss of basic cations and increased concentration of soluble Al^{3+} and limited availability of indispensable nutrients. Therefore, this study was conducted to find outAl tolerant sunflower cultivars as influenced by boron treatment based on morpho-physiological, and biochemical traits.Two experiments were conducted in the Plant Physiology Laboratory and Net House of Department of Crop Botany, Bangladesh Agricultural University, Mymensingh. In the first experiment, six sunflower genotypes were exposed to germination test under three Al levels (Al toxicity imposed by $AlCl_3$); 0 µM $AlCl_3$ (no Al), 100 µM $AlCl_3$, 200 µM $AlCl_3$. According to the germination, vigor index and morphological traits, four genotypes performed better and were selected for 2nd experiment in pot under four different Al and Boron combinations viz. 0 µM $AlCl_3$ + 0 µM boron, 100 µM $AlCl_3$, 100 µM $AlCl_3$ + 25 µM boron, 100 µM $AlCl_3$+ 50 µM boron.In the specific case of Al toxicity in pot culture, B reduces phytotoxicity by increasing total chlorophyll and proline content in the leaf.Tolerant genotypes exhibited minimum relative reduction of morpho-physiological properties and increased leaf proline content compared to sensitive ones, at vegetative stage under Al stress. Among the genotypes, Hysun 33 responded better to reduce the Al toxicity by B application and found relatively tolerant among the genotypes on morpho-physiological and biochemical attributes under different treatments. Our results imply that greater B application leads to a greater resistance to Altoxicity, a fact that might be significant for higher productivity of sunflower grown in acid soils. The relativelytolerant sunflower cultivars found in these experiments could be recommended for the experimentation field trial at naturally Al toxicity affected areas of Bangladesh.

Production Potentials of Maize Germplasms for Drought Tolerance in the Northern Charland of Bangladesh

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Abstract

Charlands are highly dynamic, and no systemic crop cultivation is practiced in this area due to unavailability of seeds of early & short duration drought tolerant crop varieties. Scarcity of water is a severe environmental constraint to plant productivity. Drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress are critical. For this, it is necessary to find out short duration drought tolerant crops varieties for charland areas.Drought stress severely affects the growth of maize. Therefore, a pot experiment was conducted at the Crop Botany Field Laboratory of Bangladesh Agricultural University (BAU), Mymensinghto evaluate the effects of drought on morpho-physiological and biochemical traits of five maize varieties. A two-factor experiment (two drought levels *viz.*, 80% field capacity and 40% field capacity and five varieties *viz.*, BARI Hybrid Maize-9, Dekalb 981, BWMRI Maize-1, Dekalb-9120 and Kaveri-50) was laid out in a completely randomized design (CRD) with three replications. Plants received full drought on 30 DAS, and after 60 days of full stress, different morpho-physiological and biochemical parameters such as root length, shoot length, root fresh weight, shoot fresh weight, total fresh weight, root dry weight, shoot dry weight, total dry weight, root shoot ratio, leave length, panicle length, relative greenness (SPAD), chlorophyll content, carotenoids content, proline content and total antioxidant capacity were studied. The length of the cob, cob breadth, kernel line/cob, kernel/line, weight of the cob, no. of kernel/cob, 100-kernel weight, and yield (t/ha) parameters were studied after harvesting. In all maize genotypes, the effects of drought stress on every morphological, physiological, and biochemical parameter were significant. Among the five varieties Dekalb 981, BWMRI-1 and BHM-9 maintained better performance in morpho-physiological parameters in drought stress conditions. In the case of biochemical traits, BWMRI Maize-1 showed better performance. Thus, based on overall observation it might be suggested that Dekalb 981, BWMRI-1 and BHM-9showed improved tolerance in almost all studied parameters whereas Kaveri-50 and Dekalb-9120 exhibited a relatively high level of sensitivity to drought stress in all the studied parameters. Tolerant varieties showed a minimum reduction of morpho-physiological and biochemical properties under drought stress. Further study is needed to evaluate the varieties in the field condition.

Evaluation of Profitable and Agro-Ecologically Suitable Cropping Pattern Considering Soil Fertility for Increasing Cropping Intensity in Northern Region of Bangladesh

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Abstract

Increasing cropping intensity in rice-based cropping system is very important for food security, poverty alleviation and livelihood improvement. The main challenge is to produce more food in limited area and the most important option is to increase cropping intensity by producing three or more crops over the same piece of land in a year maintaining soil fertility. To develop agro-ecologically suitable and profitable intensive cropping patterns with proper fertilizer combinations, the project activities were done during the second year (2021-22) to develop suitable combination of organic and inorganic fertilizers in selected cropping patterns for maintaining soil fertility at Gabtoli, Bogura and Mithapukur, Rangpur locations. The trial was carried out in RCBD factorial with three dispersed replications. Factor A, selected two profitable cropping patterns from 1st year experiment i.e. CP_1= Mustard (BARI Sarisha-14)-Mungbean (BARI Mung-6)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan75) [for Bogura] or Potato (BARI Alu-25)-Maize (Kaveri)/Sesbania (Local)-T. Aman (BRRI dhan75) [For Rangpur]; CP_2= Potato (BARI Alu-

25)/Sweet gourd (Sweety)-Jute (BJRI Toshapat-8)-T. Aman (BRRI dhan75) for both locations with the base line pattern CP_0 (existing) = Boro rice (BRRI dhan28)-Fallow-T. Aman rice (Swarna) and another factor, Factor B i.e. six different fertilizer management practices like (i) T_1= Recommended dose i.e. 100% chemical fertilizers (CF) as FRG' 2018]; (ii) T_2= IPNS basis STB fertilizer (with 5 t/ha cowdung); (iii) T_3= IPNS basis STB fertilizer (with 3 t/ha vermicompost); (iv) T_4= INM basis STB fertilizer (with 5 t/ha cowdung); (v) T_5= INM basis STB fertilizer (with 3 t/ha vermicompost) and (vi) T_6= Farmer's practice (Control). A total of 9 trial farmers of which 3 farmers for each of three cropping patterns with about 0.13 ha of cultivable land per farmer suitable for the were selected. The findings of 2nd year trial in Rangpur showed that the whole pattern REY was higher in T_4 (13.65 t ha^{-1}) followed by T_5 (13.49 t ha^{-1}) for Boro-Fallow-T. Aman pattern. For Potato-Maize/Sesbania-T. Aman pattern, the whole pattern REY was higher in T_4 (33.32 t ha^{-1}) followed by T_5 (33.29 t ha^{-1}). Like the other patterns, in the case of Potato/Sweet gourd-Jute-T. Aman, the whole pattern REY was higher in T_4 (33.25 t ha^{-1}) followed by T_5 (32.97 t ha^{-1}). In Bogura location, the whole pattern REY was higher in T_4 (14.59 t ha^{-1}) followed by T_5 (13.98 t ha^{-1}) for Boro-Fallow-T. Aman pattern. For Mustard-Mungbean-T. Aus-T. Aman pattern, the whole pattern REY was higher in T_5 (19.46 t ha^{-1}) followed by T_4 (18.41 t ha^{-1}). Like the other patterns, in the case of Potato/Sweet gourd-Jute-T. Aman, The whole pattern REY was higher in T_5 (30.72 t ha^{-1}) followed by T_4 (29.17 t ha^{-1}). In case of economic return analysis, for two proposed patterns i.e. Potato-Maize/Sesbania-T. Aman and Potato/Sweet gourd-Jute-T. Aman patterns, the whole pattern highest gross return was found higher from T_4followed by T_5. But the whole pattern gross margin was much higher in T_4than T_5 at Rangpur loation. But at Bougra location, two proposed patterns i.e. Mustard-Mungbean-T. Aus-T. Aman and Potato/Sweet gourd-Jute-T. Aman patterns, the whole pattern highest gross return and gross margin was found higher from T5followed by T_4. Finally, two profitable and promising cropping patterns i.e. Potato/Sweet gourd-Jute-T. Aman and Potato-Maize-Sesbania-T. Aman (Rangpur location) whereas Potato/Sweet gourd-Jute-T. Aman and Mustard-Mungbean-T. Aus-T. Aman (Bogura location) and two fertilizer packages i.e. INM basis STB fertilizer (with 5 t/ha cowdung) and INM basis STB fertilizer (with 3 t/ha vermicompost)have been found better and selected for 3rd year trial to validate the suitable combinations of organic and inorganic fertilizers for increasing productivity maintaining soil fertility with the selected cropping patterns.

Species Richness and Diversity in Zingiberaceae at Bangladesh Agricultural University Botanical Garden

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Abstract
A study was conducted during January 2022 to December 2023 at Bangladesh Agricultural University Botanical Garden (BAUBG) to assess species diversity of Zingiberaceae family, to record their flowering time, ethno-botanical uses and conservation status. Diverse plant species collected from home and abroad are being conserved at BAUBG to make it as a live germplasms centre. Among those, a total of 46 species under 14 genera belong to three tribes of the ginger family were recorded. The tribe Zingibereae (6 genera and 21species) had the highest species diversity, of which the genus *Curcuma* comprised of 7 species followed by the genus *Zingiber* (6 species).The tribe Alpinieae, with five genera and sixteen species, is the second most diverse, with *Alpinia* (8 species), *Amomum* (4 species), *Elettaria* (1 species), *Etlingera* (2 species) and *Plagiostachys* (1 species). Globbeae, the third tribe, consisted of only one genus namely *Globba* (7 species). The most of the species born flowering bloom during March to August in the BAUBG. The plants of Zingiberaceae were popularly used as foods, spice, medicine, ornamentals and in ritual activities. Eight species have been identified as of least concern and are conferred in the IUCN Red List, while two rare species were reported in Bangladesh Red Data: Plants. While as per Saensouk(2011) criteria, six species were identified as rare and two species as endemic to Bangladesh. This study will be the baseline of zinger species of Bangladesh and will aid in documenting their various uses.

Pigeonpea (*Cajanus Cajan*) Green Seed Yield and Quality Affected By Sowing Date and Density, and Its Inclusion for Preparation of 'Pigeonpea-Roti', A Potential Alternative to Staple Rice

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Abstract
Physiologically matured green seeds of pigeonpea (*Cajanus cajan*)rich in fibre, proteins, vitamins, minerals and phytochemicals of health benefit. It can be utilized as an alternative to green peas (*Pisum sativum*), being incorporated to many dishes as vegetables, roti, dhal, soup and curry. For green seeds, traditional pigeonpea seeds are usually shown in April and harvested in February, next year, and seed yield is decreased with delayed sowing-time.But such yield loss can be compensated by sowing seeds in increased density in late-plantingusing quantitative short day pigeonpea. Hence, the current research was designed to investigate the effect of three sowing dates (mid-April, control; mid-June, mid-August, late-sowing) and two spacings (1m x 1m, 1m x 0.05m) on the yield and quality of green seeds and its inclusion in the 'Roti'- a staple alternative to Rice.Six treatments (3 sowing dates x 2 spacings) were laid out in field in RCBD using three replications. The plot size was 3m x 3m and standard cultural protocol was used. Of the three sowing dates, the plants from the first two dates (mid-April, mid-June) were harvested while the green pods from the third sowing (mid-August)are still immature, yet to be harvested. Hence, the green pod and seed yield of mid-April and mid-June sowings would be presented. Results revealed that the green pod yield/plantwas much grater in mid-April sowing with 1m x1m spacing (780 g/plant) than mid-June sowing with 1m x 0.5m spacing (341/plant)but,interestingly, yield/plot was similar; 7.020 kg (1m x1m spacing with 9 plants/plot) in former and 6.138 kg was in latter (1m x0.5m spacing with 18 plants/plot). The green seed yield is on average 50% of the fresh pods yield.From the result, it could be concluded that in the late-sowing crop, green pod and seed yield could be increased by sowing atthe high density, when compared to early sowing (mid-April) in the quantitative short-day pigeonpea genotype.

Morphophysiological Trait, Nutritional Composition, Yield and Quality of Selected Coloured Rice Genotypes

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Abstract
Coloured rice is becoming popular and is consumed as functional food due to its nutritional and health benefits. It is richer in proteins, vitamins, minerals antioxidants and dietary fibre than common white rice. Following standard protocols, experiments were carried out at the Field Laboratory of the Department of Crop Botany and Crop Physiology Laboratory, Department of Crop Botany; Bangladesh Agricultural University, Mymensingh, during the aman season (August-Nov'21) to study the variations in canopy trait, proximate and phytonutrient compositions, yield and quality attributes of eleven coloured-grain rice genotypes namely Vojon, Binadhan-20, BRRI dhan84, Genotype-1, Genotype-2, Genotype-3, Genotype-4, Genotype-5, Genotype-6 and Genotype-7 along with a check variety Binadhan-7. The field experiment was laid out in the randomized complete block design with three replications. All genotypes were transplanted on 11 August 2021 using 30-days old seedlings and were harvested in November 2021. Data on plant height, chlorophyll content of flag leaf, root length, flag leaf area, total number of tillers hill-1, number of effective tillers hill-1, panicle length, and number of spikelet panicle-1, 1000-seed weight and paddy yield hill-1 and hectare-1, and harvest index were recorded. Proximate composition and phytochemical investigations were estimated following standard protocols. It was noted that, Binadhan-20, Genotype-4 and Genotype-5 showed higher plant height (av. 120.85 cm). Total number of tillers hill-1 was higher in the Binadhan-7, Binadhan-20 and Genotype-4 (av. 19.4) and higher flag leaf area was in the Vojon and Genotype-5 (av. 39.93 cm2). Fertile spikelet was higher in the Binadhan-20, BRRI dhan84 and Genotype-5 (av. 84.49%) and in the Vojon (80.82%). Vojon, Binadhan-20, BRRI dhan84 and Genotype-5 showed higher grain and biological yield (av. 3.78 t

ha-1 and av. 8.04 t ha-1, respectively). Five black rice genotypes namely Genotype-1, Genotype-2, Genotype-5, Genotype-6 and Genotype-7 showed higher total phenolic content (av. 9.54 mg GAE/g), total flavonoid content (av. 5.97 QE/g), total anthocyanin content (av. 0.108 µg/g) and DPPH- radical scavenging activity i.e. lower IC50 value (av. 26.03 µg/ml). Results showed that bran of coloured rice genotypes contained higher proximate composition than that of endosperm. Results revealed that Vojon, Binadhan-20, BRRI dhan84 and a black rice genotype; Genotype-5showed superiority in terms of morphophysiological traits, yield and yield attributes and grain quality whereas five black rice genotypes (Genotype-1, Genotype-2, Genotype-5, Genotype-6 and Genotype-7) and four red rice genotypes (Vojon, Binadhan-20, BRRI dhan84, Genotype-4) were better in terms nutritional aspect than common white rice. In general, Genotype-5, a black rice genotype showed superiority in terms of yield and yield attributes and nutritional compositions.

Effect of Auxin-Transport-Inhibitor and Defoliation on Wood Biomass Formation in Hardwood Trees

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Abstract
Environmental factors and endogenous components of trees interact to influence the formation of wood. Endogenous components such as auxin, plays an important role on wood biomass formation. Auxin is produced in young needles and/or elongating shoots and is transported basipetally to the cambium. It appears to be an essential stimulant of cambial cell division and the formation of xylem cells. In this study, cambial growth such as initiation of new cell plates in the cambium, pattern of cell division and xylem differentiation, number of layers of fusiform cambial cells, layers of expanding xylem cells and mature xylem cells were investigated and compared the results within control, NPA treated and defoliated seedlings. Removal of apical sources and inhibition of the supply of IAA to the cambium decreases levels of IAA in cambial regions. Decreases in levels of IAA in cambial regions are associated with the inhibition of cambial activity and xylem differentiation. In addition, auxin-transport inhibitors, such as N-(1-naphthyl) phthalamic acid (NPA), inhibit the polar transport of auxin and drastically decrease xylem production below the corresponding treated portions of hardwood stems. Moreover, the application of NPA on the stem inhibits the formation of wood in hardwood trees**.** In addition, defoliation of leaves induced slower rate of cambial activity and xylem differentiation. Therefore, it can be hypothesized that, a supply of adequate auxin and an increase in levels of auxin in cambial regions, via polar transport from buds and leaves, might increase wood biomass production as well as wood quality and quantity.

Cellular Mechanisms and Anatomical Adaptations of Major Crop in Coastal area of Bangladesh-Focusing Salinity Stress

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Abstract
Salinity is one of the major environmental stresses limiting crop production in many parts of the world. Every year saline affected area is increasing in an alarming rate due to the inundation by salinization from the sea in the southern part of the country. Salinity stress involves changes in various physiological, anatomical and metabolic processes, depending on severity and duration of the stress and ultimately inhibits crop production. However, few information available on salinity stress in relation with the cellular mechanism of crop adaptation. The present results of anatomical traits showed that cell wall thickness of xylem vessel was increased in saline tolerant sunflower and tomato genotypes. Reduced vessel diameter of sunflower roots in response to saline, with the reduction proportional to the severity of the salinity and greater reduction was observed under more severe saline condition. Interestingly, the saline-resistant genotypes showed smaller xylem vessel diameters than saline susceptible ones when grown under the severe saline condition. The results suggested that the response of sunflower and tomato

genotypes to salinity stress showed same anatomical traits. Therefore, it is very important to investigate the adaptation mechanism of coastal crop plants at cellular level under saline condition.

Popularization of Polyhouse Technology and Short Duration Varieties for Safer Boro-Rice Production Escaping Flash Flood in the Haor Region of Bangladesh

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Abstract
Haor wetlands have significant ecological importance and economic contribution to the country. The occurrence of flash floods during the months of late April-May in the haor districts is a common phenomenon every year due to the intrusion of upstream flood water from India and causes colossal yield loss (10-100%) of Boro-rice, the main rice crop available for haor communities. Thus, the recurring flash flood events have become a curse for the local Haor community. The chief aim of the study is to popularize the transplanting of short-duration Boro-rice cultivars in such a way that those could be harvested within mid-April avoiding damage from a flash flood that occurs every year. Experiments were conducted in the farmers' fields at Mithamoin and Gupdighi unions under MithmoinUpazila (flood-prone areas) of Kishoregonj district during the Boro-season of 2021-22 to study the adaptive performance of two short-duration (BINA dhan10 & BRRI dhan88) and one long-duration (BRR dhan92 as a check) Boro-rice varieties for the safer harvest of short-duration rice escaping damage from a flash flood. The lifespan of the short-duration rice cultivars was 120-135 days and that of long-duration is>160 days. The selected farmers along with the concerned DAE (Department of Agricultural Extension) personnel (AEO & AAO) were trained up about the technology through an inception workshop and then inputs for Boro-cultivation were distributed among the contacts farmers under the supervision of DAE personnel. Seeds were sown on 19 November and transplanted on 26 December. Results reveal that BINA dhan10 produced the tallest plants (109.25 cm) followed by BRRI dhan88 (91.5 cm). BRRI dhan92 produced the highest number of tillers per hill, grains, and filled grains per panicle. BRRI dhan88 was harvested on 8 April followed by BINA dhan10 on 18 April till then flash flood water did not inundate experimental sites. So BRRI dhan88 followed by BINA dhan10 is preferable for Boro-rice cultivation in the haor region considered as short duration varieties. BRRI dhan92 gave the grain the highest yield (6.7 t ha^{-1}) which was higher than BRRI dhan88 (5.3t ha^{-1}) and BINA dhan10 (4.9t ha^{-1}). About 82% farmers gave very good option and even 18% farmers gave good opinion for the cultivation of short duration varieties for haor region.

Improvement of Lodging Resistance for Higher Grain Yield in Oat Using Plant Growth Regulator with Altered Sowing Time

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Abstract
Oat (*Avena sativa* L.) is one of the important cereal grains containing various nutrients, soluble fiber especially beta-glucan, reducing blood cholesterol levels, diabetes, heart diseases, and many other potential benefits. The oat plants experience lodging problems, leading to reduced grain yield. A field experiment was conducted at the Field Lab, Department of Crop Botany, BAU, during the period from November 2022 to April 2023 to study the effects of plant growth regulator Trinexapac-ethyl on lodging resistance and grain yield in an oat cultivar, BARI oat-1. Trinexapac-ethyl was sprayed at three concentrations (0, 50, and 100 ppm) at tillering and the first node visible stage. Five tillers were sampled once a week during the grain filling period to determine changes in plant height, panicle length, no. of spikes, grains/panicle, and dry weight of different parts to estimate the impacts of PGR on lodging resistance, grain yield, and its attributes. PGR-treated plants exhibited shorter plant height (155 cm) compared to untreated plants (166 cm), though higher grain yield (0.66 t/ha) was obtained in untreated plants compared to treated plants than treated plants.PGR untreated plants exhibited higher dry weights of different parts,

especially culm with a sheath, which contributed to grain yield. However, the contribution of current assimilation indicated by leaf greenness was also higher in untreated plants. WSCs, grain filling duration, grain filling rate, and 1000 grain weight showed non-significant differences between PGR-treated and untreated plants. However, days to anthesis and days to physiological maturity were also higher in PGR untreated plants. In conclusion, a PGR like Trinexapac-ethyl might reduce the plant height at a significant level, increasing the lodging resistance, but the yield is compromised under the PGR treatment in this study.

Contribution of Culm Water Soluble Carbohydrates to Grain Filling in Grain and Fodder Type Oats (*Avena sativa* L.)

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Abstract
Oats (*Avena sativa* L.) are commonly farmed as a grain and/or fodder crop worldwide. This crop's importance is rising globally due to its higher health benefits and ease of growing. The grain filling process, which affects grain weight, is one of the key elements in cereal grain yield. Culm reserves and current assimilation have an impact on oat grain filling. To investigate the grain filling pattern and contribution of culm water-soluble carbohydrates to grain in oats, a field experiment was carried out at the field laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, from November 2021 to April 2022. Two oat genotypes were used in the experiment such as i) BARI Oat-1 as grain type and ii) a genotype collected from CCBDF in Savar as fodder type**.** The experiment was laid out in a Randomized Complete Block Design with three replications. Five tillers were sampled once a week during the grain filling period to determine the changes in dry weights of different parts, viz., leaves, culm with sheath, panicles, and grains, and to examine the grain filling pattern in the two genotypes. Data on phenological traits, grain yield, and its attributes were recorded. The bulk of the traits under investigation revealed substantial differences between the two genotypes—grain and fodder types. In the trial, the grain type genotype (BARI Oat-1) produced a higher grain yield (0.939 tha^{-1}) compared to the fodder type genotype (0.8713 t ha^{-1}). The grain from the grain type genotype weighted 93.90 g m^{-2} compared to 87.13 g m^{-2} for the fodder type genotype. The grain-filling duration was the same for both genotypes. The grain type genotype exhibited a higher weight of 1000 grain than the fodder type genotype, and the 1000 grain weight of the two genotypes was 31.13 g and 28.83 g, respectively. Grain type oat cultivar, BARI Oat-1, contained higher water-soluble carbohydrates in culm and contributed more to grain in oats than the fodder type genotype studied.

Morpho-Physiological and Biochemical Characterization of BAU Dhan-3 Against Salinity and Drought Stress

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Abstract
BAU Dhan-3 has been the recent sensation as appropriate replacement of mega variety BRRI dhan 28 and BRRI dhan 29 for boro season. It is an early, blast resistant and high yielding rice variety. Due to recent outbreak of neck blast of rice, BRRI dhan28 and BRRI dhan29suffered severely, whereas, BAUDhan-3, country's only blast resistant rice variety comes as a savior. Moreover, from field report it has been found that, BAU Dhan-3 demonstrated strong tolerance to abiotic stresses like cold at seedling stage and gusty hot wind during panicle development, whereas most of the commonly cultivated rice variety in Boro season got affected by the aforementioned stresses recently. All of these features indicate huge potential of BAU Dhan-3 to have differential mechanisms of tolerance features against other abiotic stresses. Therefore, the present research proposal is aimed to diagnose BAU Dhan-3 for its response against salinity and drought stress based on morpho-physiological and biochemical attributes. To investigate the response against salinity, an experiment is going in present Boro season, at the Farm research Lab, Dept. of Genetics and Plant Breeding, BAU, where, plants of BAU Dhan-3 along with 3 other salt tolerant and

susceptible varieties were raised pot with coarse yellow sand. Salinity was induced by adding NaCl with nutrient solution to keep 10 dsm-1 salinity. NaCl treatment was started on 21 days old plant. Plants are now raised with control and NaCl treatment to observe the affect of salinity on the rice cultivars considered. Another experiment is also going on to evaluate the response of BAU Dhan-3 along with 3 other drought tolerant and susceptible varieties in present Boro season at field condition. Drought stress was induced by withdrawing irrigation at different level of growth and development. Detailed results will be presented once the data is available.

Enhancing Heat Tolerance in Wheat by Using Affordable Seed Priming Methods for Farmers

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Abstract

The goal of this study is to find natural and affordable seed priming agents that can counteract the negative effects of high temperature stress on wheat. Four different types of seed priming agents (Moringa leaf extract-MLE, Neem leaf extract-NLE, Combination of MLE+NLE, and $CaCl_2$) with control (no seed primed) were tested at varying concentrations on two wheat genotypes, Sonalika and WMRI Gom 1 to induce tolerance against heat stress. The experiment evaluated 16 diverse morphological traits which eventually contribute grain yield of wheat under heat stress. Results indicate that the WMRI Gom 1 was more responsive to seed treatment than Sonalika. The combined seed treatment helped the Sonalika genotype to demonstrate superior performance for chlorophyll content and grain yield, while the $CaCl_2$ treatment showed better outcomes in the WMRI Gom 1 genotype in terms of these two traits. For canopy temperature depression, the $CaCl_2$ treatment was more effective in the Sonalika genotype, while the MLE+NLE treatment was superior for the WMRI Gom 1 genotype. Likewise, the $CaCl_2$ treatment showed better membrane thermostability in the Sonalika genotype, while the NLE treatment was more effective for this trait in the WMRI Gom 1 genotype. The MLE+NLE treatment was more effective in the WMRI Gom 1 genotype for days to grain filling, while the NLE treatment was better for the Sonalika genotype's days to maturity. The MLE treatment exhibited good performance in the Sonalika genotype for straw yield, while the WMRI Gom 1 genotype performed better with the NLE treatment. However, the MLE+NLE treatment performed better for both genotypes in terms of 100 grain yield. The study found that natural seed priming agents (MLE, NLE, MLE+NLE) were more effective than the chemical agents ($CaCl_2$), with the MLE+NLE combination exhibiting the best performance among all the seed treatments considering cost effectiveness, easy formulation and availability. Seed priming agents improve a plant's defense mechanisms against abiotic stress, enable plants to tolerate heat stress, by continuing growth, and production of grains through favorable metabolic activities. This results through a cooler canopy, uncompromised chlorophyll levels, desirable membrane thermostability, and enhanced grain filling duration, and increased grain weight, which ultimately leads to better yield under heat-stress conditions. Therefore, using seed priming agents can help to decrease canopy temperature and enhance plant resistance to heat stress.

Response of Major Varieties of Rice and Wheat Against Lead (Pb) Contamination in Bangladesh

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Abstract

Pb toxicity in soil is increasing day by day due to heavy industrialization, increasing use of Pb-based batteries and poor recycling facilities. However, we have no preparation to fight against Pb toxicity in crop lands. Therefore, our crop production and food safety are at risk. Considering that, the present project was conducted to find out morphological and biochemical responses of major wheat and rice varieties against 800 ppm $Pb(NO_3)_2$ toxicity. From the investigation, it was evident that, none of our major rice and wheat varieties have tolerance to Pb toxicity, rather severely susceptible and affected by Pb toxicity through reduced morphological and biochemical responses. Among the wheat varieties, four varieties *viz.* BARI Gom 30, BARI Gom 31, BARI Gom 33 and Sonalika have

found with gradient of responses for morphological traits, and none of the varieties were found with clear stand to be declared with Pb tolerance for all the traits. For biochemical responses, similar findings were also revealed, and none of the varieties demonstrated strong anti-oxidant defense mechanism, rather poor proline-defense system in them. Similar to wheat, prominent rice varieties were also found to susceptibility to Pb toxicity in both morphological and biochemical responses. None of the rice variety had shown consistent better response against Pb toxicity, but variable response to different morphological and biochemical traits. Biochemical mechanisms are not strong enough to scavenge the ROS molecules and oxidative damages. Henceforth, it can be concluded that, none our major rice and wheat varieties are tolerant to Pb toxicity, rather very much susceptible. Therefore, Pb tolerance in wheat and rice should be looked out from the related genetic resources of different strata to help breeders to develop Pb toxicity tolerant cereal variety to ensure food safety and well as food security.

Introgression of Blast Resistance Genes into Elite Rice Cultivar BRRIdhan 28 through Marker-Assisted Selection

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Abstract
BRRIdhan28 an early maturing mega variety for Boro season in Bangladesh and has the largest area under cultivation.However, BB and blast explosion are highly occurred in this variety at Boro season 2022-23, which was almost difficult to control by severe spraying of fungicides.It is possible to keep this variety in farmer's field for a long time by improvingBRRIdhan28 through pyramiding of efficient blast resistance genes.In the present study, we introgressed two genes (*Pi2* and *Pi54*)governing resistance to ofrice blast disease into a popular rice cultivarBRRIdhan28 throughmarker assisted backcross breeding (MABB).In foreground selection, seven plants homozygousfor all the four genes were selected from a population of 180BC_2F_2plants and subjected tobackground selection coupled with phenotypic selectionfor agronomic and grain quality traits of therecurrent parent. Six NILs from the BC_2F_2families with an RPG recovery ranging from 82.5% to90.5% were phenotypically evaluated foragronomic performance, grain quality traits anddisease resistance. The level of resistance to blast diseases in all the selected NILs was similar tothat of the donor parent. The NILs were recorded a disease score of 1.0 and 1.7 for two blastisolates collected from Muktagacha and Bajitpur, respectively. The NILs were almost similar to BRRIdhan28 for majoragronomic and grain quality traits with the advantageof resistance to blast diseases.The improved NILsneed to further testin multi-locations, which would help to estimate their performance for commercial cultivars. These NILsof BRRIdhan28wouldprovide an economical and sustainable assurance forthe farmers against losses due to blast diseasesin the future.

Marker Assisted Introgression of Target Alleles into Maize for Bio-Fortification

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Abstract
Micronutrient malnutrition, commonly known as "hidden hunger," is a major health problem worldwide, especially in underdeveloped and developing countries. Among micronutrients, vitamin A plays a central role in human metabolism. Cereals are a rich source of energy, but lack the necessary micronutrient content. Genetic improvement of plant micronutrients through plant breeding, known as "biofortification", is a cost-effective and sustainable process in which micronutrients reach the target population in their natural form. Traditional yellow corn contains lowprovitamin A (provitA) and little lysine and tryptophan. The development of maize enriched with ProA, lysine and tryptophan is therefore important to alleviate micronutrient malnutrition. In this study, marker stacking of *crtRB1*, *lcyE* and *o2* was performed to increase β-carotene, lysine and tryptophan in maize. HP704-22 and HP704-23 were used as donors, four elite parents of two popular hybrids were used as recipients. Twenty-two double-crossed BC_1F_1 offspring were developed, from which two progeny carried both *crtRB1* and *o2* target alleles, with

80–85% recovery of the recipient parent gene. An introgressedBC_1F_1 had a high provitA content (6.3–10.5 µg/g). Lysine and tryptophan were also increased in BC_1F_1 offspring. The two selected BC_1F_1 offspring can effectively be used as potential females for later crossing with the recipient parent. Biofortified maize rich in provitA, lysine and tryptophan will be used to regenerate hybrids with increased provitA, lysine, tryptophan and higher yield.

Characterization of Wheat (*triticum aestivum* L.) Genotypes for Drought Stress Tolerance

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Abstract

Wheat holds immense significance in global agriculture due to its wide adaptability and nutritional importance for human consumption. However, the sustainability of wheat production and global food security are at risk due to declining yields attributed to drought stress. This study aims to evaluate the impact of drought stress on various morpho-physiological traits and to identify drought tolerant wheat genotypes for breeding programs. It comprised of two experiments involving 18 genotypes at seedling stage in growth chamber and 14 genotypes using field capacity in pot and rainfed conditions in field. At seedling stage, PEG 6000 was used for imposing drought stress whereas different drought stress conditions were applied in field. Based on the mean performances and Multi Trait Stability Index (MTSI) analysis, Sawghat, Prodip and Opata were found to be superior drought tolerant genotypes at seedling stage. In field condition, the estimation of the genotypic and phenotypic coefficients of variation showed that the phenotypic coefficient of variation was higher than the genotypic coefficient of variation for most of the studied traits. Heritability values ranged from 5.42% for grain per plant to 99.38% for yield per plant in stressed condition and from 0.80% for grain per spike to 64.13% for days to germination in rainfed condition. Principal Component Analysis (PCA) highlighted that the first five components accounted for 88% of total variation, with traits like grain/plant, yield/plant (g), number of tiller/plant, spike length (cm), hundred grain weight (g), days to 50% flowering and flag leaf length (cm) showing the highest variability. In field experiment, Sawghat, NK-5, Prodip, Protiva and Shourov showed better performance for drought tolerance, exhibiting superiority across various traits including yield and yield attributing. The best-performing genotypes can be used in future breeding programs for developing drought-tolerant and high-yielding variety to ensure sustainable food security in Bangladesh.

Ammi and Gge Biplot Analysis for Yield and Yield Attributing Traits of Spring Wheat (*triticum aestivum* l.) Under Terminal Heat Stress Condition

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Abstract

For sustainable agricultural development and prosperity, it is essential to maintain stability and develop high yield wheat genotypes under adverse conditions. This study examined the impact of genotype by environment (G × E) interactions on yield stability in a range of environments using thirty-five wheat accessions in a randomized complete block design (RCBD) with three replications. Significant differences ($p < 0.01$) were found in the analysis of variance between genotypes, environments and their interactions, suggesting a high degree of variability in performance in those test conditions. A two-dimensional GGE biplot was used to illustrate how different genotypes performed in various environments, which accounted for 96.15% and 3.24% difference in GEI for yield per plant. It also identified stable and high-yielding genotypes like G4, G10, G34, and G35. The genotype ability was given greater consideration by the AMMI model, which determined that G34 was the best performer across several variables. The genotype ranking showed G34, G33, G32 and G31 were the most promising genotypes with a high mean yield and stability under terminal heat stress conditions. Based on AEC line, G33 and G31 were more stable, whereas, G1 and G29 were less. The intricate relationships between genotypes and surroundings were efficiently visualized by GGE and AMMI biplots, thereby making it possible to classify genotypes into three categories. The assessment procedure became easy through this graphical representation, which helped to clarify how well a genotype adapt and commercially cultivated in various adverse environmental conditions.

Molecular and Biochemical Marker-Based Identification of Diversity of Blast Resistant (Baudhan 3) and Susceptible (Brri Dhan 28/Brri Dhan 29) Rice Variety

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Abstract

Rice blast caused by *Magnoporthe oryzae* is a major devastating fungal disease and represent a potential threat for world rice productions. However, information about genetic and biochemical basis of disease tolerance is still limited. In this study, we tested the presence and diversity of resistant R genes using SSR markers, and the antioxidant enzymes catalase (CAT), ascorbate peroxidise (APX) and guaicol peroxidise (POD), activity and also the concentration of hydrogen peroxide (H_2O_2) and malondialdehyde (MDA) in resistant (BAUdhan 3) and susceptible (BRRIdhan 28) genotype. Molecular marker analysis reveals the presence of all ten studied resistant genes in BAUdhan 3. Among the marker studied, three markers namely RM224, RM72 and RM206 produce distinct band only in resistant genotype BAUdhan 3, which might be used to screen resistant genotype. The enzymatic activity of APX, CAT and POD increased in the inoculated plant for both cultivars but the increase were more prominent for BAUdhan 3. The *M. oryzae* infections significantly increased the H_2O_2 content in BRRIdhan 28 and not much changed in BAUdhan 3. The MDA concentration was higher in the leaves of inoculated plants of BRRIdhan 28. The higher activities of APX and POD in the leaves of the inoculated plants of BAUdhan 3 resulted in lower H_2O_2 accumulation which can minimize the cellular damages possibly caused by reactive oxygen species. The result shows that presence of more resistance gene and effective antioxidative system in BAUdhan 3, which limits the damage caused due to fungal infection and thus contributing greater resistance.

Selection of Zinc (Zn) and Iron (Fe) Enriched Wheat Genotypes and Ssr Marker Based Molecular Characterization

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Abstract

Wheat (*Triticum aestivum* L.) is a major cereal which contributes about 28% of the world's food demand and a great source of different micronutrients like Zn and Fe. A study was conducted using thirty wheat genotypes to select the superior genotypes having higher yield and Zinc content, and also to find out the association between Zn content and yield contributing traits. The genotypes were also further checked for the presence of Zn linked QTL using gene specific molecular markers (SSR). The results of analysis of variance (ANOVA) showed significant genetic variation for all of the studied traits. Maximum GCV and PCV were recorded for Zn and Fe content. PCV is higher than GCV for days to germination, flag leaf area, grain per spike and grain per plant. High heritability along with high genetic advance was recorded for chlorophyll content, plant height, shoot length, Fe and Zn content. Grain yield plant^{-1} showed significant positive correlation with number of grain spike^{-1}, 100-grain weight. Zn and Fe content showed significant negative correlation with canopy temperature. The studied genotypes were grouped into 4 major clusters and cluster III is important for micronutrient content. Genotypes Pavan & DSN-76 for Fe content, DSN-117, Ning 3517 & BAW 897 for Zn content have been identified as superior genotypes. BAW 667 & BAW 897 found superior for both Zn content and yield. Molecular markers showing polymorphic band, indicating the presence of diversity among studied thirty wheat genotypes. Among the used markers, barc144 & gwm359 related QTL is found to be important for higher Zn content which is related to higher Zn content in BAW897 genotypes. The selected genotypes will be further used to as potential genetic material for development of Zn bio-fortified wheat variety.

Smart Breeding for Accelerating Genetic Gain in Rice by the Application of Artificial Intelligence and Traditional Techniques

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Abstract

The research work was conducted at the Field Laboratory of Department of Genetics plant Breeding (GPB) at Bangladesh Agricultural University (BAU), Mymensingh-2202, during July, 2022 to June, 2023 with a view to find out effect on the yield performance of some promising HYV rice cultivars. The experiment compromised of twenty five HYV viz., V1, V2, V3, V4, V5, V6, V7, V8, V9, V10, V11, V12, V13, V14, V15, V16, V17, V18, V19, V20, V21, V22, V23, V24, V25 and it was laid out in a randomized complete block design (RCBD). Numbers of total 25 varieties and individual unit size was 5 x 2 m. After sampling the whole plots were harvested at maturity (when 90% seeds became golden yellow in color). Data were recorded on different agronomic characters days of 50% flowering, days of 80% maturity, plant height (cm), effective tillers hill^{-1}, fertile spikelet's panicle^{-1}, sterile spikelet's panicle^{-1}, Grains panicle^{-1}, 1000-grain weight and grain yield from the randomly selected five hills in each unit. All the relevant data were analyzed by using the "Analysis of variance" (ANOVA) technique and mean differences were adjusted by Duncan's Multiple Range Test (DMRT).Marker aided analyses were done to find out *Sub1* genes in any variety followed standard protocols. Promising HYV rice cultivars differed significantly (1%) for most of the yield contributing characters. The combined result of present studies revealed that the BRRIdhan29 & BAU dhan3 were most promising based on maximum effective tiller per hill, highest number of fertile spikelet and highest 1000 grain weight. So, BRRI dhan 29 and BAU dhan 3 are very much promising HYV rice cultivars. Weather data and field results were analysed based on available record and all the possible machineries and smart tools were used for getting accurate data. However, in depth analyses may produce perfect features in near future which might be added rapid data gathering and ultimately will add a value of smart breeding.

Molecular Breeding of Soybean for Drought Tolerance and Quality Protein Approaches

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Abstract

Different plants response differently to drought stress. Abiotic stresses such as drought induced diverse physiological and molecular responses in plants. These responses include changes in gene expression. One of drought tolerance gene is a gene encoding dehydrin which belongs to the group II or *D*-11 *LEA* protein family. *LEA-D*11 gene produces dehydrin protein which has a role in stabilization of membrane structures and protection of macromolecules in the presence of drought. Identification and characterization of drought tolerant gene for developing molecular marker and selecting genetic variation in plants are very useful. The aim of the study was to identify and to characterize soybean genotypes using *Lea* gene specific primers through PCR based detection technique as well as spectrophotometry for the soybean protein quality. Subsequent breeding programs through repeated backcrossing and recurrent selection will be very helpful for rapid generation advancement (RGA) and for varietal release of soybean. The genotypes Shohag, SBM-09, Binasoybean-6, PK-416 and YESOY-4 might be drought stress tolerant as they have low yield reduction (<35%) and low protein degradation. The genotypes G-10180 and Binasoybean-1 were the most susceptible as calculated higher yield reduction (>85%) under drought stress.

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Development of Advanced Breeding Lines from Diverse Rice Genotypes for Developing Climate Resilient Rice Variety

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Abstract

The development of advanced breeding lines, followed by their characterization, offers a significant opportunity to isolate potential genotypes with desired traits of interest for developing climate resilient rice variety.Twenty-five advanced (F_6) cross-breeding lines along with parents and check varieties were evaluated for their yield and earliness under field conditions. Based on the traits under consideration, few advanced lines (Line 10, 12, 21, 22, 23, 24, and 25) were classified as early high-yieldinggenotypes. In addition, salt tolerance of four advanced (F_5) breeding lines (Line 8, 10, 11, and12) was also carried out at the reproductive stage along with salt tolerance and salt susceptible varieties. Based on the findings,Line 10 and 12 were categorized salt tolerant lines.Similarly, low phosphorus (P)stress tolerance was evaluated using four advanced cross breeding lines and mutants (Line 3, Line 4, Line 6 and Line 20) along with Binadhan-17, BRRI dhan49 at the net house of the field experimental farm of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh, using a RCBD design with three replication and two treatments (control and low P stress).Based on characteristics of yield attributes and stress tolerance indices, Binadhan-17 and Line 20 was categorized as low P tolerant. We also studied the drought stress tolerance of four advanced high-yielding rice mutants (Line 14, 16, 20, and 22) along with drought tolerant (BRRI dhan71 andNerica 10) and drought susceptible check (BRRI dhan49) at the reproductive stage under pot-culture conditions. Based on yield attributes and stress tolerance indices Line20 was categorized as drought tolerant. Therefore, the advanced breeding lines selected from different experiments could be considered as potential sources for developing early, high-yielding and stress tolerant rice varieties.

Evaluation of Advanced Breeding Lines of Rice Developed From Fatemadhan for Earliness, Yield and Salinity Tolerance

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Abstract

The purpose of the research study was to characterize 22 mutants (gamma-irradiated) of rice derived from Fatemadhanfor yield attributing traits as well as salinity tolerance of few advanced mutants developed through EMS-mutagenesis. The seeds of the mutants were grown at the field experimental farm of the Dept. of Genetics & Plant Breeding, Bangladesh Agricultural University, Mymensingh, Bangladesh. Few mutants exhibited superiorperformance as compared to parent and check varieties. Mutant lines 1 and 83 required minimum days to mature, whereas, the mutant lines 9, 17 & 80 exhibited significantly higher yield per plant. Thus, the promising mutant lines (lines 1, 9, 17, 80 & 83) isolated in this study can be used for developing early, high-yielding rice varieties. For assessing salinity tolerance, two experiments were conducted using few advanced mutants at the seedling and reproductive stages of rice growth. In the first experiment, seedlings were grown under hydroponic conditions and 14-day-old seedlings were subjected to salinity (EC= 10 dS/m; 7 d). Salt stress caused a significant decrease in root and shoots traits and chlorophyll content. In contrast, a sharp increase in shoot Na^+/K^+ ratio was found in all the genotypes but a little increase was found in tolerant genotypes (Binadhan-10, FL-478 and Line-1). The second experiment was conducted in a large plastic-tub filled with field soil and at the end of heading stage rice plants were irrigated with saline (EC=10 dS/m) water for 21-days. Salt stress resulted in a significant yield related traits in all the genotypes studied. Considering both of the experimental results, Line-1 could be selected as a seedling and reproductive stage salinity tolerant mutant. However, further studies are required to isolate the key genes controlling salt tolerance of Line-1 and high-yield potential of Line-65 under control condition for developing salt tolerant high-yielding rice varieties.

Characterization of Agro-morphological Traits Along with Protein Content of Pigeonpea (*Cajanuscajan* L.) Genotypes Available in Bangladesh

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Abstract
Pigeonpea is a perennial legume with extraordinary sources of high-quality protein, essential amino acids, fatty acids, fibers, minerals, and vitamins,which are used as food, feed and also enrich soil health. Thepresent studywas undertaken to measure the phenotypic variability among 22 pigeonpea genotypes following aRandomized Complete Block Design with three replications. Highly significant variation was found among the genotypes for all the studiedtraits. The phenotypic coefficient ofvariationwas greater than the genotypic coefficient of variation for all the traits. The estimated heritability ranged from low to high. High heritability coupled with high genetic advance, and genetic gain in percentage of mean were recorded for number of seeds pod^{-1} number of pods plant^{-1} number of seeds$plant^{-1}$ seed yield plant^{-1} and hundred seed weight. In correlation study, at both phenotypic and genotypic levels, seed yield plant^{-1} had a significant and positive correlation with number of seeds pod^{-1}, number of pods plant^{-1}, number of seeds plant^{-1}, seed yield plant^{-1} and hundred seed weight. Path analysis revealed that days to first pod formation, numbers of pod plant^{-1}, number of seeds pod^{-1}, hundred seed weight and number of seeds plant^{-1} exerted direct positive effect on seed yield plant^{-1} in phenotypic and genotypic association levels. Principal Component Analysis revealed the cumulative variance of 71.15% by the first three Principal Component. The studied 22 genotypes were also grouped into 4 clusters, where maximum genotypes were in Cluster IV and minimum in Cluster III. Thehighest inter-cluster distance (9.17) was found between cluster III and cluster I, indicating the presence of wider genetic diversity among the genotypes of these clusters. Hence, the genotypes of those clusters may be used as parents in breeding program.

Assessment of Pre-Breeding Materials and Breeding for Development of Melon Genotypes with Desired Yield and Fruit Quality Traits

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Abstract
Rockmelon (*Cucumis melo* L.) is a popular fruit rich in nutrients, antioxidants and vitamins. Native cultivars of Bangladesh often lack sweetness, flavour, and shelf life and hence,are not preferred by consumers. Development of pre-breeding populations from native and exotic genotypes are essential.We characterizedthe performance of 33 diverse genotype in terms of agronomic and fruit quality traits. The highest TSS content (%brix) was found in genotype ML-994(13.9) followed by M-AG-01 (11.9) and M-HW-(11.2). Panel test score also identified these genotypes as most preferred genotypes. The double-cross hybridfruits had low TSS (brix <8%).Moderate phenotypic co-efficient of variation and genotypic co-efficient of variation were observed for the number of bisexual flowers, number of branching, sugar content and fruit weight. We have developed the F_2 seeds as well which are being evaluated. The way forward will be to develop subsequent generations and finding heterotic parental combinations. These findings offer valuable insights for future breeding programs aiming at enhancing rockmelon germplasm for improved fruit quality traits.

Screening of Salt Tolerant of Mungbean (*vignaradiata*l.) Genotypes and Identification of Morpho-Physiological and Biochemical Markers Linked to Salt Stress

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Abstract
Mungbean is one of the major pulses in Bangladesh, and it is also an essential part of the food habits of Bangladeshi people. But salt, which is going to be severe day by day in Bangladesh, is a major threat to mungbean production. Therefore, the phenotyping of mungbean germplasm has a significant effect on its future use in breeding programs to identify salt-tolerant mungbean genotypes. Considering this fact, three experiments were conducted to evaluate the performance of 30 mungbean genotypes collected from PRC, BARI, BINA, and the World Vegetable Center, India. The first experiment was conducted at the plant growth chamber, the department of genetics and plant breeding, BAU, for screening salt tolerance genotypes at the seedling stage, and salt stress was imposed at 10 dSm^{-1} by adding NaCl salt for 72 hrs. Among the studied 30 genotypes, only 1 genotype, V1003785, was found to be highly tolerant, with a minimum reduction in the growth parameters and a high salt tolerance index (STI). Six genotypes (BARI mung 4, E-65, E-91, E-92, BMXKI (15001-6), and BMXKI (15008-1) were found to be tolerant to salt, while the genotypes BARI mung 2, BARI mung 5, and Binamoog 9 were sensitive to salt, with a maximum reduction in growth parameters along with lower STI values. To know the morphological characterization and diversity of the studied genotypes, the second experiment was performed at the Field Laboratory, Department of Genetics and Plant Breeding, BAU, in RCB design with three replications. ANOVA indicated the differences among genotypes for all the morphological traits. The phenotypic coefficient of variance (PCV) was higher than the genotypic coefficient of variance (GCV) in all of the studied traits. Moderate to high heritability (range from 50 to 93%) was found for all traits. High heritability along with high genetic advance was found for the number of pod $plant^{-1}$ (62.7), number of seed pod^{-1}(50.2), pod length (45.6) and plant height (58.1). A significant positive correlation was found for most of the studied characters. The genotypes were grouped into four different clusters to determine the genetic diversity. The genotypes that showed tolerance were in two different groups. To know the insight mechanism of salt tolerance for the selected (both salt-tolerant (8) and sensitive (2)) genotypes, the third experiment was performed at the plant molecular genetics laboratory, the department of genetics and plant breeding, BAU, to measure biomolecules linked to salt stress (hydrogen peroxide (H_2O_2), malondialdehyde (MDA), peroxidase (POD), catalase (CAT), ascorbate peroxidase (APX), glutathione S-transferase (GST), and glutathione reductase(GR)). The amount of all biomolecules was higher in salt stress compared to control. The amount of oxidizing makers H_2O_2 and MDA increased more in sensitive genotypes compared to tolerant genotypes. The proline (Osmoprotectant) and antioxidant enzyme activities were higher in tolerant genotypes than in sensitive genotypes. Therefore, considering all of the information, the genotypes V1003785, BARI mung 4, and E-92 could be good plant materials to grow in a salt-affected southern region of Bangladesh with moderate salt stress conditions. Evolved information can be exploited for further breeding purposes in developing salt-tolerant mungbean genotypes.

Risks of Rooftop Gardening in Urban Agriculture: Assessing Residents' Perceptions

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Abstract
Rooftop gardening is a novel approach to urban agriculture that makes best use of urban spaces to enhance environmental sustainability, dietary and nutritional security, and economic strength.However, there are some risks related to rooftop gardening that need to be identified and reduced to encourage rooftop growers.As a result, the current study was designedto examine the perceived risks of rooftop gardeningamong the residents of Kewatkhali

and Aqua in Mymensingh, Bangladesh.From September to November 2022, data was collected from 100 randomly chosen rooftop growers using a structured interview schedule. To examine the data, descriptive statistics, rank order, coefficient of correlation, and multiple linear regression were used.The results showed that nearly all of the rooftop growers in the study area perceived the risks of rooftop gardening at a medium (86%) to high (14%) level.'Associated technologies are too complex' was identified as the most important risk indicator out of seventeen.The indicator with the lowest ranking was 'negative attitude of neighbors'. The correlation analysis revealed that age, rooftop garden area, total income, experience, extension media interaction, and knowledge of rooftop gardening were all negatively significant to residents' perceived risks of rooftop gardening.According to the findings of the regression analysis, the area and knowledge of rooftop gardening had a significant impact on the perceived risks of rooftop gardening.Expansion of research, demonstration and extension activities, and development of residents' skills and understanding through effective training could all help to reduce the risks of rooftop growers.

Eco-Friendly Practices for Vegetable Cultivation: Farmers' Knowledge and Use

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Abstract
The injudicious use of pesticides by the farmers in vegetable cultivation is a severe challenge that causes risk to human health and contaminates the environment. The study aimed toassess the knowledge level of vegetable growers, extent of use of eco-friendly practices and explore the relationships between farmers' characteristics and their knowledge and use of eco-friendly practices. The locale of the study was Baghabo village of Shibpur upazila under Narsingdi district where 112 vegetable farmers were interviewed. Knowledge was measured by applying Bloom's Taxonomy and the use through 4-point rating scale. Descriptive statistics were used but for exploring relationships, the Pearson's Product Moment Correlation was employed. The findings revealed that the majority (71.4%) of farmers had moderate to high level (28.6%) of knowledge on eco-friendly practices. Our analysis on Bloom's taxonomy of knowledge indicated that a significant proportion of the respondents obtained the highest average score (78.56%) in application level followed by remembering level (71.02%).The findings concerning the extent of use of eco-friendly practices indicated that the highest proportion of the farmers (60.14%) used occasionallyfollowed by frequently (24.20%). Among the 24 selected eco-friendly practices, the first ranked practice under current use was 'using traps (pheromone traps)' while 'use of polytunnel', 'soil treatment', 'collection and destruction of infected plant parts' and 'crop rotation' were the 3rd, 4th and 5th raked practices. The result of correlation analyses showed that farmers' educational status, experience on vegetable farming, training exposure,and extension contacthad positive significant relationship for both their knowledge and extent of use of eco-friendly practices. However, farmers' attitude towards eco-friendly practices had significant positive relationship only their knowledge. Our results conclude that the farmers' lack enough knowledge in understanding, analyzing, and creativity level may hamper their effective use of eco-friendly practices for vegetable cultivation.

Smallholder Farmers' Perception of Climate Change and Extent of Adoption of Climate Smart Agricultural Practices: A Study of Char Areas in Jamalpur District

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Abstract
Climate change has become a significant global issue that affects many different industries and communities across the globe. Farmers, whose livelihoods are closely correlated with weather patterns, precipitation, and temperature swings, are among those most susceptible to its impacts.The purposes of the study were to determine the perception

of the smallholder farmers regarding climate change issue and explore the factors that may influence their perception. The study was conducted at Chikajani and Chukaibarivillages of Dewanganj upazila under Jamalpur district. Dewanganj upazila was selected purposively as the study area had greater numbers of char areas that are mostly vulnerable to various climate change impacts.The smallholder farmers of the study area were 331Deof them 200 (60%) were taken as sample using simple random sampling technique. Data was collected using a structured interview scheduleduringOctober5 to December 27, 2023. The focus variable (smallholder farmers' perception on climate change) measured by using a 5-point Likert rating scale with responses like 'strongly disagree', 'disagree', 'undecided', 'agree' and 'strongly agree' with the corresponding scores such as 1, 2, 3, 4 and 5. Farmers' socio-economic characteristics were considered as the explanatory variables of the study. The highest proportion (90.5%) of the smallholder farmers had favorable perception whereas 6% had strongly favorable perception and 3.5% had neutral on climate change issue. The results of the multiple linear regression analysis indicated that extension media contact, level of education, access to source of climate change information and cosmopoliteness were the influential variables that could have a significant impact on smallholder farmers' perception. Results from stepwise multiple regression analysis indicated that extension media contact alone contributed 70.5% of the variations.The Department of Agricultural Extension (DAE), national and local NGOs consider these findings to promote climate change interventions in char areas.

Effect of Value Chain Strategies on Livelihood Status of the Commercial Fish Farmers Engaged in Conversion from Crop Farming to Aquaculture

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Abstract

The main purpose of the study was to determine the extent of effect of value chain strategies on the livelihood status of the commercial fish farmers engaged in conversion from crop farming to Aquaculture. The specific objectives of the study were (i) To determine the extent of livelihood improvement of the commercial fish farmers due to their involvement in value chain process for fish farming. The aspects of livelihood improvement status include: family assets and shelter, social empowerment, bargaining capacity; (ii) To explore the relationship of selected characteristics of the commercial fish farmers with their extent of livelihood improvement, and (iii) To determine the problems faced by the commercial fish farmers in implementing value chain process and suggestions to overcome those problems. This study location was Dhanikhola union of Trishal Upazila of Mymensingh district. As Dhanikhola is the leading union where the frequency of rice farming to aquaculture is a common phenomenon. Based on Livelihood Improvement Status Index (LlSl) of the 30 activities top three activities of three aspects were i) Cattle (211.8); ii) Family planning (236.2) and iii) Knowledge on price of milk in the market (273.5). Near about two-thirds (62.7 percent) of the farmers had medium improvement, 19.6 percent low and 17.6 percent had high improvement. Thus, majority (82.3 percent) of the farmers had low to medium improvement in three aspects (assets and shelter, social empowerment and bargaining capacity). Among the nine selected characteristics of the farmers seven like educational qualification, farm size, annual family income, extension media contact and cosmopoliteness, savings and attitude towards RDRS showed significant positive relationship with their livelihood improvement, while their age, family size had no relationships. Lack of communication between buyers and producers (93.14 percent) emerged as the most important problem opined by the farmers. The least (84.31percent) problem mentioned by the farmer was lack of knowledge regarding value chain process in the farmers' level. The prime (95.10 percent) suggestion cited by the farmers was collaborative action can be taken by GOs and NGOs to improve the transport system. Capacity building training regarding this context can be increased among farmers' level (50.00 percent) was suggested by the farmers as the least suggestion.

An Assessment of Farmers' Willingness to Adopt Prescription-Based Pesticide Use Guidelines by Extension Professionals

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Abstract
Bangladesh, a small agrarian country in Asia, has enormous population to feed and therefore, heavily rely on pesticides. The government is trying to reduce human health hazards caused by harmful chemicals to fulfil the SDG target 3 (good health and wellbeing). In this connection, this study wasdesigned to know prescription-based pesticide use relatedproposed guidelines by the professionals of Department of Agricultural Extension (DAE), andto assess farmers' willingness to adopt the proposed guidelines.The study followed both qualitative and quantitative approaches.Writtendiscourseswere gathered from purposively selectednewspaper articles andsocial media (i.e.,Facebook). Spoken discourses were collected from the key resource persons of Plant Protection Wing of DAEthrough informal discussions, key informant interviews (KII), and Focus Group Discussions.'Content analysis' and 'narrative analysis' were usedto knowthe proposed guidelines.Bamberg's stage model of self-regulated behavioral change (SSBC) was used as analytical tool to develop structured interview schedule for face-to-face interview of 150 vegetable farmers. The farmer level study was conducted in 3 purposively selected villages of Melandah, Islampur, and Dewanganj upazilas of Jamalpur district. Findings revealed that majorityof the farmers had medium (68%)to high (29.3%) willingness to adopt prescription-based pesticide use related guidelines. Almost all the farmers were willing to see and visit plant doctor's clinic and mobile clinic in their locality.A great majority of the farmers were willing to receive prescription from retired government and private sector officials as plant doctors. However, majority of the farmers were unwilling to pay for plant doctors and internet facilities and are not interested to use internet-based apps to receive prescription. Qualitative analysis also implies that 'prescription for solving pest problem' is not an obligation in pesticide use and trade but an expectation to increase farmers' awareness in ensuring judicial use of pesticides.

Effectiveness of Farmer Field School Approach for Technology Adoption: A Study in Mymensingh District

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Abstract
The Farmer Field School (FFS) approach, developed by Food and Agriculture Organization of the United Nations (FAO), is a hands-on training method in which farmers test management methods/production technologies for themselves and learn concepts directly. In practice, an FFS is composed of groups of farmers who meet regularly during the course of the growing seasons of a particular crop to experiment as a group with new production options. The main focus of the present study was to determine the extent of adoption of selected rice production technologies in a selected area through FFS approach. The other objectives were (i) to assess the sustainability of technologies transferred through the FFS approach; (ii) to determine factors affecting transfer of technologies to the farmers; and (iii) to investigate the strengths and weakness of Integrated Farm Component (IFM) FFS methodology. The study was conducted in Ishwarganj upazila under Mymensingh district, where the Department of Agricultural Extension (DAE) under the Ministry of Agriculture, implemented FFSs under Integrated Farm Management Component (IFM) project.A sample of 182 FFS farmers and 156 non-FFS farmers was chosen for the studyusing random sampling and snow-ball technique, respectively. Among 21 rice FFS practices ten were selected through a judge rating process. Data were collected by a Research Fellow through face-to-face interviews using a pre-tested structured interview schedule from August, 2022 to January, 2023.The Statistical Package for Social Sciences (SPSS) 20 software was employed in analyzing primary data. As per results, the adoption rate was found to be higher among the FFS farmers compared to non-FFS farmers. For overall adoption, it was found that the majority of the FFS farmers (75.9%) had medium adoption of FFS technologies followed by 22.5% having high adoption. On the other hand, majority of the

non-FFS farmers (71.8%) had medium adoption followed by 26.3% had low adoption of FFS technologies. Farmers' risk orientation, innovativeness, market access and knowledge on FFS were found having significant contribution to the variation of their adoption of FFS technologies. Strengths and weaknesses of the FFS approach have also been identified.

Developing Extension Strategies for Producing Safe Mangoes at Farmer Level: A Study in Chapainawabganj, Bangladesh

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Abstract
Fruit crops play an important role in the national food security of people around the world. Mango (Mangifera indica L.) is one of the most common and popular fruit and often mentioned as the 'King of fruits' due to its excellent flavor, attractive color, delicious taste and high nutritive value. The objectives of the project were: i) to determine farmers' present practices related to soil fertility, pest and post-harvest management of mango production, ii) to assess on-going programmes of DAE for safe mango production, iii) to formulate appropriate extension strategies for safe mango production by farmers. Data were collected from15th April to 13th May, 2022 using semi-structured interview schedule from 100 mango farmers of four villages of shibgonj upazila under chapainawabganj district. Appropriate scales were developed in order to measure the variables. Descriptive statistics such as mean, standard deviation, range and percentage were used to describe the variables under consideration. About (63.33%) of the mango farmers had medium practice, while (24.17%) farmers had low practice and only (12.5%) farmers had high practice of modern techniques. Among the 100 respondents, 85% used chemical fertilizers (Urea, TSP, MP, gypsum) and 15% respondents used organic fertilizer (cow dung) in their orchards. Most of the respondents (67%) used chemical pesticides for disease-pest control and hormones for early or late ripening of mango fruits. DAE provides campaigning, group discussions and training for safe mango production but, most of the mango growers (65%) opined that these are not sufficient and regular. After two FGD's, (82%) farmers were suggested that extension organizations can provide training, method and result demonstrations, awareness campaigning, organic fertilizers and pesticides, regular monitoring to increase the safe mango production. Besides, proper marketing and storing facilities, developing mango fruit processing industries in the study area can also motivates for producing safe mango.

Ensuring Food Safety through Pre-Harvest Interval for Pesticide Use: Identification of Knowledge, Attitude and Pesticide Use Pattern by Vegetable Farmers

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Abstract
The study was conducted to (i) determine the knowledge of vegetable farmers towards the use of the pesticides and (ii) To evaluate the extent of practice of pre-harvest interval (PHI) by the vegetable farmers. A total of 100 vegetable farmers were interviewed by using a structured interview schedule from 4 Villages of Shibganjupazila of Bogura district at their houses and/or farm sites during February to August 2022 and it drew from a population 288 using simple random sampling technique. Fourteen (14) selected characteristics of vegetable farmers viz.: age,education, family size, farm size, experience of vegetable farming,area under vegetable farming, annual family income, organizational participation, extension media contact, training receive, access to market, decision-making ability, knowledge on PHI and attitude towards PHI and were considered as the explanatory variables.54% of the farmers belonged to medium knowledge group, while 30% of farmers had low knowledge and 16% had high knowledge towards the use of the pesticides in vegetable cultivation.A 10-point rating scale was used to measure the extent of practice of pre-harvest interval (PHI). Most of the farmers (91%) practice 0-2 days to 3-5 days category of PHI and

very little portion (9%) practice 6-8 days to > 8 days category of PHI. It indicates that safe category of PHI practice was very poor. Majority portion (62%) had practiced 0-2 days of PHI at the beginning month of the season, whereas large portion (77%) had practiced 6-8 days to >8days of PHI in the last month of the season. It reveals that the farmers practice of highly toxic category of PHI in the beginning month of the season and safe category of PHI practice in the closing month of the season.

Assessing the Livelihood Changes of Char land People due to Practice of Selected BAURES Project Interventions

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Abstract

Char land area is recognized as a vulnerable area of Bangladesh where a good number of people, particularly farmers, have been struggling against several natural calamities. Like other organizations, BAURES has been implementing several projects for the improvement of char land farmers. Thus, the study was undertaken mainly to explore the livelihood changes of char land farmers due to the practice of selected BAURES project interventions, determine the beneficiaries' satisfaction with the services provided by the BAURES project, and identify the problems faced by the char land farmers while practicing the project interventions. The study was conducted in two villages named Pathalia and Lakshmir Char of Pourashova and 3 no. Lakshmir Char union under Sadar Upazilla in Jamalpur district because, one of the important projects ("Upliftment of Farmers Livelihood and Enrichment of Environment through Improved Agroforestry Practices in Char Land Ecosystem of Bangladesh"), administered by BAURES was implemented in these areas. The project provided different interventions (seedlings, saplings, seeds, fertilizers, pesticides, and training) to the char land farmers during its implementation. Appropriate scales and scores were used to measure the variables of the study. One hundred and three project beneficiaries were selected using a simple random technique as a sample from the population of 207 given by the co-principal investigator of the project. A structured questionnaire was prepared through the conduction of two focus group discussions and two key informant interviews, in addition to literature reviews. The necessary data will be collected through a questionnaire survey. The following results are expected: the status of livelihood change among the farmers, the extent of farmers satisfaction due to the use of the BAURES project interventions, and the problems faced by the farmers while practicing the selected BAURES project interventions will be identified. An MS thesis is also expected to be prepared.

Capacity Strengthening of Char Women for Household Food Security Under COVID-19 Pandemic Situation

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Abstract

Food security and adequate nutrition are among the basic needs of every human being. Bangladesh has achieved self-sufficiency in food availability. However, around 11% of the population still live in extreme poverty (below the lower poverty line) and are unable to afford a basic food consumption basket (HIES, 2016). After COVID-19 pandemic, the situation has worsened resulting millions of people had fallen under poverty line. It is assumed that the overburden on the health sector causes the reallocation of resources to the health sector to save lives. That may reduce the purchasing capacity of poor people and affect household food security. Apart from the prevailing deficit in total calorie intake, the normal diet of people of Bangladesh is seriously imbalanced, with more than 80 percent of calories derived from cereals. This dietary imbalance reflects insufficient domestic production of non-cereal foods (pulses, oilseeds, meat, milk and eggs), low incomes, food preferences and lack of nutrition education. Women can play vital role in achieving food security at household level. This study focuses on the capacity strengthening of char women as these households are more vulnerable. The existing status of household food security was assessed and

their need for capacity building was identified. The locale of the study was two villages of shampur union of Melandahupazila under Jamalpur district. A total of 90 households were selected as sample of the study and women of the households were the respondents.Data were collected by using a structured interview schedule during 15 February to 15 March 2023. Need for capacity building of women was the dependent variable and the eleven selected characteristics of the respondents constituted the independent variables. To measure the extent of need for capacity building of char women, four dimensions of capacity building were included. These were i) need for decision making ability ii) need for access to support services iii) need for management skill iv) need for physical facilities. The dimensions were measured on a four-point rating scale i.e. 'no;, 'low', 'medium', 'high' and scores were assigned as 0, 1, 2, 3 respectively. There was total 21 aspects under four dimensions. The highest proportion (66.7%) of the respondents had medium need while the rest (33.3%) of them had highest need for capacity building and none of them had low extent of need for capacity building. Among the characteristics of the respondents, extension media contact, decision making ability and knowledge on food utilization showed significant negative relationship with their need for capacity building.

Assessing Adoption and Diffusion of Agricultural Innovations in Bangladesh

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Abstract

Adoption of new technologies aimed at increasing agricultural output, such as innovative farm machinery, crop-based mixed-balanced fertilizers, high-yielding crop types, vegetables, and fruits, has been very strong, and productivity has increased. The anecdotal evidence and opportunistic observations imply that the technology and ideas used by farmers are not always those backed by Bangladesh's government. Anecdotal information from industry professionals and important stakeholders, on the other hand, reveals that the technologies and innovations used in the country's farming systems are frequently imported from neighboring countries. Unfortunately, there is no comprehensive study of whether Bangladesh rural farmers use homegrown of foreign agricultural advances. The key objectives of the project are to identify the adoption characteristics of agricultural technology users in the agricultural value chain of Bangladesh and to explicate the attitudes and values of the users with specific reference toward adopting local versus foreign agricultural technologies. These behavioral elements will then be used to explore the facilitating and hindering factors that influence the adoption and diffusion of the home-grown agricultural innovations in Bangladesh. Finally, optimal policy recommendations will be formulated to promote adoption of homegrown agricultural technologies and innovations. Several expert consultations made it possible to help identify and chose significant agricultural technologies for in-depth investigations of their adoption and diffusion characteristics from among the hundreds of developed and available technologies in the country. Various in-depth interviews and FGDs were conducted in five zones of the country – North East, North West, Central, South East and South East. Both quantitative and qualitative data would be analyzed applying various modern methods and report would be prepared very soon.

Shifting of Conventional Agriculture towards High Value Enterprise for Better Livelihood of the Rural People

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Abstract

Transformation is evident not only in the form of commercialization of farming and achieving food autarky, but also development of rural non-farm sectors and overall improvement of livelihoods of rural people. This study was undertaken to investigate the nature of shifting of selected conventional agricultural practices towards high value enterprises and its impact on livelihoods of the members of farming communities. Three component organizations, namely Department of Agricultural Extension Education, BAU, Bangladesh Agricultural Research Council and *Sheba Sangstha* (an NGO) have been jointly executing the research project. For BAU component, two agricultural

practices under huge transformation were selected and was planned to investigate in specific, appropriate locations. The selected research locales are Chars of Gibandha (Barren chars' shift into special sandbar farming) and Bandarbansadarupazila (natural vegetation into fruit orchard). Data were collected from ranges of respondents that include farmers, market and input actors, agricultural extension personnel, researchers, NGO staff, local government bodies and other key informants. A total of 870 persons were interviewed by using structured questionnaire and checklists (FGD, KII and Stakeholder Workshop). These methods were followed after desk review and preliminary assessment of the study locations, and were finalized through and inception workshop of the project. The fieldworks in two locations are complete. A number of FGD, KII and Stakeholder Workshop have been conducted while some capacity development training was already organized. The results of the data analysis would be completed by April 2024 and report would be prepared very soon.

Production and Post-harvest Processing of Aloe Vera Gel for Industrial Use

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Abstract

Aloe vera gel has acquired commercial importance for medicinal products and cosmetics processing but information related to gel processing is scarce. In this experiment, centrifugation was employed for the extraction of gel from Aloe vera leaves. The effects of speed and duration on gel recovery was studied. The treatments consisted of three levels of centrifuge speed (5000, 10,000 and 15,000 rpm) and three levels of centrifuge duration (20, 30 and 40 minutes). The experiment was planned using two factors following Completely Randomized Design with three replications. Itwas concluded that the extraction of gel from Aloe vera leaf should be carried out using 10,000 rpm speed and 30 min duration of centrifugeso as to obtain higher gel recovery from the leaf.

Yield and Nutritional Quality of Black Rice and Brri Dhan-87 Under Organic and Inorganic Fertilization

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Abstract

Black rice contains carbohydrates, vitamins, essential nutrients and amino acids BRRI dhan87 has been gaining popularity among farmers. This experiment was conducted at the field laboratory of the department of Agronomy and the laboratory analysis was done in the department of Agricultural Chemistry, BAU, Mymensingh. The experiment was laid out in a completely randomized design (CRD) with different combinations of inorganic fertilizer (IF) and decomposed cow dung (CD) having six (IF0CD0, IF100CD0, IF75 CD25, IF50CD50, IF25CD75, IF0CD100) treatments and three replications. The aim of this research is to conduct a thorough examination of how combining inorganic fertilizers (IF) with cow dung (CD) affects the yield, nutritional qualities, and growth characteristics of black rice and BRRI dhan87. The results revealed that each rice was significantly affected by different combinations of IF and CD. Except plant height the highest numbers of total tillers hill-1, fertile tillers hill-1, panicle length, grains panicle-1, grain and straw yield were obtained when 75% of inorganic fertilizer + 25% of cow dung was applied. Conversely, plant height, nitrogen, protein, phosphorus and potassium contents reached their maximum levels in the treatment IF100CD0.Though the yield of BRRI dhan87 was almost double than black rice, protein and nutritional qualities except few were significantly higher in black rice compared to BRRI dhan87. The highest quantity of starch, iron, zinc and manganese concentrations were found in the highest additions of cow dung (IF0CD100). The research concludes that 75% of inorganic ertilizer + 25% of cow dung can be applied for overall growth, yield, and nutritional attributes of both rice.

Comparative Evaluation of Heavy Metal Contamination in Potato Tubers Cultivated in the Greater Mymensingh Area of Bangladesh for Human Health Risk Assessment

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Abstract
This study was undertaken to determine heavy metal concentrations in potato tubers cultivated in 4 Upazilanamely,Muktagacha, Fulpur, Gafargaon, and Ishwarganj of Mymensingh district, Bangladesh. In total 24 sites were selected from the aforementioned Upazilas. Four(4) potato tubers and 3 soil samples were collected from each location of the farmer′s field. Thus, this study handled a total of 96 potato tubersand 72 soil samples, which were analyzed for different heavy metals by atomic absorption spectrophotometer (AAS). The mean concentrations ofPb, Ni, Cd, Co, Cr, Cu, Fe, Mn, and Znin potato tubers werebdl (<0.010), 1.408, 0.0075, bdl (<0.010), bdl (<0.010), 1.502, 8.935, 1.940, and 5.151 µg g^{-1} (fresh wt.), respectively and in soils were12.97, 63.84, 0.14,5.68,63.63,17.96,26608, 662.4 and61.45 µg g^{-1}, respectively.The calculated potential ecological risk index (PERI) indicated that the soils of potato-cultivating regions of the study area are ecologically free from pollution.On the other hand, the average calculated hazard quotient (HQ) values for Zn, Cu, Fe, Mn, Ni and Cd were 15.90, 34.78, 11.82, 12.84, 65.22, and 6.96 for males, and 22.26, 48.69, 16.55, 17.97, 91.31, and 9.74 for females, respectively, which indicate non-carcinogenic human health risks (HQ> 1.00) of these metals due to dietary intake of potato tubers.However, the calculated incremental lifetime cancer risks (ILCR) posed by Cd and Ni due to oral exposure to potato tubers varied from 0.00E+00 to 1.93E-01 and 0.00E+00 to 2.48E+00 in males, 0.00E+00 to 2.70E-01 and 0.00E+00 to 3.47E+00 in females, respectively. The study results revealed that the calculated ILCR values for Cd in 96% of samples and Ni in 83% of samples were several hundred times higher for males and females than the threshold (1.00×10^{-6} to 1.00×10^{-4})of USEPA. Such high ILCR values suggested that consumers who ate potato tubers grown in the area were at much higher cancer risks.In contrast, both the calculated HQ and ILCR values werenegligible for Pb, Cr and Co in all samples indicating potato tuber samples were below the non-carcinogenic and carcinogenic risks threshold.

Vermicomposting of Water Hyacinth for Sustainable Vegetable Crop Production towards Organic Farming

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Abstract
Vermicomposting is an ecofriendly technology for converting organic waste *viz*., water hyacinth as ubiquitous aquatic weed into valuable organic fertilizer for sustainable vegetable crop production. The present study was aimed to assess the status of plant nutrients after vermicomposting period for different proportions of substrates. In this experiment, water hyacinth (WH) and cow dung (CD) were used as substrates. Experiments were comprised of five treatments: T_1 - Control (without earthworm); T_2 - 100% CD; T_3 - 25% WH + 75% CD; T_4 - 50% WH + 50% CD and T_5 - 75% WH + 25% CD. As control treatment, same experimental set up without earthworm was also maintained. The feasibility of vermicomposting of water hyacinth (WH) mixed with cow dung (CD) in different proportions was tested using indigenous earthworm (*Eisenia fetida*). Earthworms grew and reproduced normally until the incorporation of water hyacinth as substrate during vermicomposting period. The status of plant nutrients during mineralization of wastes was studied. The results revealed that earthworm species efficiently converted substrate mixture (*i.e.* T_4 - 50% WH + 50% CD) into value added material (*i.e*. vermicompost) that were enrich with plant nutrients (N, P, K, Ca, Mg, S, Zn and B) with reduction in organic C as well as C:N ratio in different experimental beddings as compared to control treatment after 75 to 90 days of earthworm activity. Vermicomposting in T_4 treatment resulted in high productivity of vermicompost followed by T_3 treatment, which was due to preferential palatability of earthworms towards mixed composting material. From the present study, it is

concluded that water hyacinth could be potentially useful as raw material in vermicomposting of organic waste with solving disposal problem into useful organic fertilizer in the environment and increasing plant nutrient for sustainable vegetable crop cultivation with reduction of environmental pollution caused by chemical fertilizers towards organic farming.

Application of Biochar and Activated Carbon Adsorbents for Removal of Heavy Metals from Wastewater

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Abstract
Heavy metal contamination in the untreated industrial wastewater has become a serious environmental problem. Wastewater reuse for irrigation is a widespread practice in the periurban areas of Bangladesh. For this reason, heavy metal removal from wastewater is of prime importance for a clean environment. Wastewater samples were collected to determine pH, EC, TDS and the levels of heavy metal ions *viz*. Cd, Cr, Cu, Pb, Mn and Zn from hand-loom dyeing, textile, dyeing and tannery industries at Belkuchi upazila, Sirajgonj district; Bhaluka upazila, Mymensingh district and Savar upazila, Dhaka district. The level of heavy metals in samples was analyzed by atomic absorption spectrometric method. In batch sorption experiments, samples were shaken in shaking incubator at 25°C and 200 rpm by adding adsorbents at rates of 0.05, 0.10 and 0.20% (w/v), respectively. Aliquots were taken at 0, 1, 3, 6, 12 and 24 h intervals. Samples were acidic to alkaline (pH=4.8-10.6) and were problematic for irrigation usage. In wastewater samples, TDS values ranged from 634 to 1,030 mg L^{-1} and EC values varied from 946 to 1,534 µS cm^{-1}. As per FAO standard, the levels of Cr ion in tannery wastewater and Mn ion in textile wastewater were above the permissible limits for irrigation indicating contaminants. Accordingly, these ions were considered for sorption experiments. As compared to control treatment, 35% and 45% of Cr ion was removed from tannery wastewater sample and 30% and 40% of Mn ion was adsorbed from textile wastewater sample within 24 h by treating 0.20% (w/v) granular and powdered activated carbons, respectively. As compared to control treatment, the ability of rice straw biochar and water hyacinth biochar was found for removing 84% and 90% of Cr ion from tannery wastewater sample, respectively and 80% and 86% of Mn ion from textile wastewater sample within 24 h by treating 0.20% (w/v) biosorbents, respectively. Sorption efficiency was enhanced with increasing reaction time and adsorbent rate. From these findings, it is concluded that biochar could be applied as a potential biosorbent for removal of Cr and Mn ions from tannery and textile wastewater samples.

Slow Release Nitrogen Fertilizer for Improving Soil Health and Sustainable Crop Production

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Abstract
Leafy vegetables are packed with vitamins, minerals and fiber whichfills up the needs of the daily diet in human nutrition. But farmers require an ample amount of nitrogen (N) fertilizer for the production of leafy vegetables. Excessive application of synthetic fertilizers is one of the main contributing factors for reducing soil organic matter (SOM). Using slow-release organo-mineral fertilizer and itslong-term residual effect can solve this problem to some extent. The experiment was conducted at the pot house of the Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh to observe and compare the effect of conventional and slow-release N fertilizers. The research work conducted to measure the effect of urea, di-ammonium phosphate and brown coal-urea (BCU) basal and brown coal-urea top dressed treatments on the yield and N uptake by BINA Patshak-I. Total 80pots were prepared for five treatments with four replications for N doses 0, 50, 75, 100 and 150 kg N ha^{-1} following completely randomized design. The highest plant height, leaves $plant^{-1}$, branches $plant^{-1}$, stem girth, fresh and dry biomass yield was recorded from BCU TD treated plants than urea, DAP and BCU basal treated plants. The best

results regarding the quantity of protein content and N uptake were found in treatment combination BCU TD 150 kg N ha^{-1}. At last, considering both the effects on yield and N use efficiency were attributed to lower N release rates of BCU TD fertilizers compared to that of the conventional N sources.Slow release BCU applied as top dressing in soils may have promising applications for sustainable agricultural development by mitigating N losses and for a longer period of residual effect.

Peat Soil Based Organo-mineral Nitrogen Fertilizer Performed Better than Urea in Improving Nutritional Quality of Baby Corn

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Abstract

Organo-mineral fertilizers (OMF) are becoming popular because of their potential to increase crop quality and yield. A pot experiment was carried out in the net house of the Department of Agricultural Chemistry, Bangladesh Agricultural University (BAU), Mymensingh to observe the effect of newly formulated peat soil urea (PSU) on the nutritional quality of baby corn (Zea mays L.) in comparison to commercial urea. The experiment was laid out following a completely randomized design (CRD) with 4 replicates. In this trial, three sources of nitrogen (N) (urea, PSU-L, and PSU-H) were used to apply N at rates of 50, 75, and 100% of the suggested N application dose. Soil application of PSU fertilizer showed a significant influence on the nutritional parameters of baby corn. A slightly higher chlorophyll a and b were found in PSU treated plants than in commercial urea. The highest cob and fodder N, P, K, Ca, Mg, S, Fe, and Zn content were found in baby corn that received PSU treatment than commercial urea treatment. The application of PSU in soil showed about 21, 15 and 20% higher N, P, and Zn uptake by baby corn, respectively than commercial urea. Again, N uptake showed a strong correlation with the uptake of other nutrients. In light of the overall findings PSU could be used as N source for the cultivation of high-quality baby corn.

Nutritional Composition and Crude Protein Levels in Kenaf (hc-95) Leaves

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Abstract

This research delves into the nutritional composition and crude protein levels of Kenaf (HC-95) leaves, aiming to understand their nutritional dynamics over the growth period. The study was conducted in the department of Agricultural Chemistry, with seeds sown on March 15, 2022, and harvested on July 15 in the same year. Samples were collected at various intervals, starting from 45 days after sowing (DAS) and concluded at 120 DAS, to analyze their nutritional composition. The analysis revealed a significant variation in crude protein content throughout the growth stages. Crude protein levels increased progressively, starting from 27.872% at 45 DAS and reaching a peak of 33.485% at 120 DAS. This indicates an accumulation of protein as the leaves mature, potentially influenced by physiological processes related to plant growth and development.Furthermore the study examined the levels of various nutrients in the leaves over time. Phosphorus (P%) exhibited its highest concentration at 90 DAS, while potassium (K%) peaked at 75 DAS. Sulfur (S%) content reached its maximum at 60 DAS, while sodium (Na%) showed dual peaks at 60 and 75 DAS. Calcium (Ca%) content was found to be highest at 120 DAS.The investigation also uncovered the lowest recorded levels of crude protein and other nutrients. The lowest crude protein percentage was observed at 45 DAS, measuring 5.096%. Similarly, the lowest levels of phosphorus, potassium, sulfur, sodium, and calcium were found at various stages, highlighting the dynamic nature of nutrient accumulation and utilization in Kenaf (HC-95) leaves throughout their growth cycle.Overall this study provides valuable insights into the nutritional profile of Kenaf HC-95 leaves, which can inform agricultural practices aimed at maximizing their nutritional value and utilization in various applications such as forage crop for cattle.

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Silicon Supplements Induce Resistance against Wheat Blast Disease

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Abstract

A field experiment was carried out at the net house of the Department of Agricultural Chemistry, BAU, Mymensingh from November 2022 to March 2023 with artificial inoculation of *Magnaporthe oryzae* Triticum pathotypeto study the effects of various silicon supplements on the blast disease incidence and severity as well as growth and yield of wheat. The test crop used in the study was the wheat variety BARI Gom26 and it was conducted in a Completely Randomized Design (CRD) with three replications. A total 24 Plots were prepared with the recommended dose of fertilizers along with different levels of Si supplements. Total 24 plots were prepared and Si supplements were applied as per treatments *viz*. Tac (absolute control treatment where all fertilizers are absent), T0 (control treatment having no Si supplement), T1 (6 mM Si L^{-1} from $MgSiO_3$ as Foliar Spray), T2 (100 kg Si ha^{-1} from $MgSiO_3$ asBasal dose), T3 (6 mM Si L^{-1} from $CaSiO_3$ as Foliar Spray), T4 (100 kg Si ha^{-1} from $CaSiO_3$ asBasal dose), T5 (100 kg Si ha^{-1} from Super Silica as Basal dose), T6 (2.5 ton ha^{-1} rice husk ash as basal dose), respectively. In the study, the efficacy of Si supplements was evaluated by observing % disease incidence, %disease severity matrix and yield pot^{-1}. All the Si supplements showed a significant reduction in disease severity in comparison to controls throughout the days after inoculation.All the silicon supplements showed a significant reduction in disease severity in comparison to controls throughout the days after inoculation. Among all of them,super silica @100 kg Si ha^{-1} showed a significant decrease in wheat blast disease severity matrix compared to both control and absolute control. $MgSiO_3$ @6 mM Si L^{-1} from $MgSiO_3$ as foliar spray and $CaSiO_3$ @6 mM Si L^{-1} from $CaSiO_3$ as foliar sprayfollowed by Si @100 kg Si ha^{-1} and rice husk ash @2.5 ton ha^{-1} showed the best result than all other basal doses of $MgSiO_3$ and $CaSiO_3$. Yield parameters showed that $CaSiO_3$ basal dose @100kg Si ha^{-1}at 55DAS showed the best results for wheat plant height.Rice husk Ash @2500kg Si ha^{-1}showed the best results for wheat spike length. The best results for total spike $plot^{-1}$, weight of seed $spike^{-1}$, total number of seed $plot^{-1}$ and yield $plot^{-1}$ (2500kg Si ha^{-1}) were observed in the plots treated with Super Silica. The flag leaf sampling was accomplished to determine the concentration of different mineral nutrients such as Ca, Mg, K, P, S, B, Si, and Na.The average concentrations of Ca, Mg, K, P, S, B, Si, and Na in the collected plant samples were 0.52%, 0.42%, 1.23%, 0.48%, 0.51%, 75.12 ppm, 4176%, and 0.41%, respectively. The highest Ca content was found in the T1 treatment (6 mM Si L^{-1} $MgSiO_3$ as Foliar Spray), the highest K and S content was found in the T4 treatment(100 kg Si ha^{-1} $CaSiO_3$), the highest Mg and Si content were in the plot treated with Super silica. From the present study, it may be concluded that Silicon supplements incorporated in the study showed a significant reduction in blast disease and at the same time higher yield in comparison with the controls. The best disease reduction was done by Super silica and rice husk ash, and $CaSiO_3$ performed well inthe reduction of wheat blast disease and had better yield than those of the basal doses of $MgSiO_3$ and $CaSiO_3$.

Lead Contamination in the Terrestrial Food Chain from Spent Lead Acid Battery Recycling and Related Health Risks: A Case Study from Mymensingh

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Abstract

Lead (Pb) contamination in Bangladesh's soil, water, and food chains is a growing issue due to the increased use of lead-acid batteries and open recycling. A study was conducted at the Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh, to assess the extent of lead pollution in the environment and terrestrial food chains from a local spent lead acid battery recycling factory situated at China Moor, Shamvuganj, in Mymensingh. The soil, water, rice grain, rice straw, pasture grass, and cow milk samples were collected from the 150-metre radius of the selected spent lead acid battery recycling factory. The pH and EC values of the collected samples were determined, and lead contents were analyzed using an atomic absorption spectrophotometer. The Pb

content in the soil of adjacent rice fields ranged from 152.67 to 6427.48 mg kg-1, much higher than the continental upper crust value and maximum safe value. The Pb content in the soil of adjacent pasture land ranged from 671.76 to 5320.61 mg kg-1, much higher than the continental upper crust value and maximum safe value. The transfer factor (TF) values for Pb for soil to rice grains, rice straw, and pasture grass were 0.007, 0.003, and 0.001, respectively, indicating lead contamination in cow milk might be mainly from grazing on contaminated pasture. The incremental lifetime cancer risk (ILCR) for Pb crossed the threshold risk limit (>10−4) in the studied contaminated rice grain and cow milk, indicating that consumption of lead-contaminated cow milk would result in an excess of 4 to 7 adult cancer cases per 10,000 people exposed and 3.6 to 6 child cancer cases per 1000 children exposed. Pb, a major carcinogen in the study area, should be controlled to prevent cancer and non-cancer health risks, and further risk assessments are needed for rice cultivation and consumption.

Biodegradation of Tannery Wastewater Using Multifunctional Bacteria Isolated From Tannery Wastewater

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Abstract
Bangladesh has a good number of tannery factories most of which operate without effluent treatment plants, causing severe water pollution and discharging toxic heavy metals, especially chromium (Cr) into the environment. This study was conducted to investigate the biodegradation of tannery wastewater using multifunctional bacteria isolated from the same source. Immediate analysis of the collected wastewater sample showed that the water was blackish-colored and severely acidic water with an EC value of 49.36 $mscm^{-1}$ and a TDS value of 24.68 g/L. The wastewater contained a huge amount of chromium (Cr) (2563.95 mg/L) and contained a significant amount of chloride (Cl^-). Whereas the amount of Ca, Mg, and P were found in acceptable limits. In the present study, we focused on the biological removal of toxic heavy metal Cr using bacteria. The isolates were characterized for the biochemical parameters including plant growth promoting traits. For the biological treatment of wastewater, three bacteria were isolated and marked as Tan-1, Tan-2, and Tan-3 in statis and shaking condition. In both condition bacterial treatment reduced the slightly the pH and EC of the tannery wastewater. All three isolates were found to be able to remove Cr with a removal efficacy of 20-50%. The highest removal is observed in the case of Tan-3 which was almost 50% followed by Tan-2 and Tan-1. It could be concluded that all the bacteria isolated from the tannery wastewater were able to reduce the chromium concentration from tannery wastewater while Tan-3 could be best option for using in the effluent treatment plant (ETP) for biological removal of chromium from tannery wastewater in a sustainable manner.

Endophytic Bacteria *Pseudomonas Mosseliii*mproves Growth, Yield and Nutrients in Rice

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Abstract
Rice is main cereal crop worldwide. Nutrient availability and pathogen attack are two most important limiting factors of rice production in our country. To combat with these limitations, farmers use synthetic fertilizers and pesticideindiscriminately which intern do long term damage soil health and environment. *Pseudomonas mosselii*, an endophytic bacterium, is known to increases plant growth and yield and effective against blast fungus*Magnaporthe oryzae*. With this context, we isolated native *P.mosselii* from rice field of a blast affected area. The isolate was characterized for plant growth promoting characteristics such as indole acetic acid production (IAA), Phosphate solubilization, N fixation, HCN production, catalase activity and NH_3 production activity. The strain was used in

rice variety BRRI dhan29 in four methodsof application namely seedling priming, root drenching, foliar application, bacterial cell free culture (CFC) foliar application.The results showed that application of *P. mosselii* significantly improved the growth parameters, increased most of the mineral nutrient contents and yield of rice. In most of the quality attributes, bacterial application showed better performance over the control. Application of bacteria increased the number of grain panicles^{-1}compared to control irrespective of method of application.Seedling priming with the bacterial solution resulted maximum plant growth and yield of rice whereas, bacterial CFC foliar application showed best results in phosphorous (P), magnesium (Mg) and Zinc (Zn) acquisition in shoot while nitrogen (N), P, Calcium (Ca) and Mg acquisition in flag leaf. This treatment also suppressed the natural occurring blast disease maximum. The results suggested rice seedling priming during transplanting along withbacterial CFC foliar application at vegetative stage could be the best management practice for application of *P. mosselii* in rice.

Nutritional and Biochemical Evaluation of the Fruits and Vegetables Grown in Soilless Cultivation Systems

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Abstract

Nitrate ions play a vital role in the growth and development of plants. Nitrate is a form of nitrogen that plants can utilize for synthesizing proteins, enzymes, and various essential molecules. Therefore, this study was conducted to evaluate the effects of various nitrate concentrations on the growth performance and nutritional qualities of sweet peppers and lettuce grown in the hydroponic system. Sweet peppers and lettuce were subjected to four nitrate treatments (0 M, 0.5 M, 1 M, and 2 M). Growth parameters, yield, proximate components, and biochemical parameters such as chlorophyll content, beta-carotene, total soluble sugar, vitamin C, antioxidant activity, and enzymatic antioxidant activity were measured. The sensory attributes of the products were also evaluated. The study found that increasing nitrate concentration progressively boosted chlorophyll, catalase, and ascorbate peroxidase activities, along with protein, ash, and fiber content in hydroponically cultivated sweet peppers.On the contrary, total soluble sugar, peroxidase activity, and carbohydrate content declined consistently with rising nitrate levels. Optimal effects were observed at 1 M nitrate concentration for parameters like fruit number and antioxidant activity. Lettuce exhibited increased leaf area, plant height, leaf width, chlorophyll, beta-carotene, sugar, ascorbate, and protein content with higher nitrate concentrations. However, root length, carbohydrates, fiber, and lipid levels decreased. Moisture, lipid, and ascorbate content showed inconsistent patterns. During the organoleptic evaluation, lettuce and sweet peppers showed almost similar characteristics to those of soil-grown vegetables at 1M and 2M nitrate concentrations, respectively. Though further studies are required, nitrate concentrations at 1M and 2M can be recommended to better produce hydroponic lettuce and sweet peppers, respectively. Therefore it can be concluded that optimizing nitrate supply in hydroponic systems has the potential to elevate the nutritional quality and market attractiveness of sweet peppers and lettuce.

Selenium Induced Modulations in Physio-Biochemical Responses, Yield and Quality of Maize under Combined Drought and Heat Stress Condition

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Abstract

Maize *(Zea mays L.)* is the third most important cereal crop in Bangladesh which is sensitive to drought and heat stress. Selenium (Se) is not an essential nutrient for plants but plays important roles in alleviating the abiotic stresses in plants. The objective of our study is to investigate the potential ameliorative effects of exogenous Se in the term

of morphological, biochemical traits under drought and heat stress. A pot experiment was conducted to assess the impact of exogenous Se in BARI Hybrid Maize-17 genotype under combined drought and heat stress. The experiment was carried out in completely randomized design (CRD) with four treatments as control (C; no stress without Se), combined drought and heat stress (DH), drought and heat + 1 µM Se (DH+Se) and no stress with 1 µM Se (Se) in triplicates. Morphological and yield contributing characters (plant height, leaf number, cob length, cob diameter, cob weight, number of cobs per plant, number of kernels per row, number of rows per cob, 100 kernels dry weight) and biochemical parameters (total phenolic contents, TPC; total flavonoid contents, TFC; total antioxidant capacity, TAC; amylose contents) were determined according to established methods. Drought and heat stress reduced plant height, leaf number, cob length, cob diameter, cob weight, number of cobs per plant, number of kernels per row, number of rows per cob, 100 kernels dry weight and amylose content. Further DH stress increased TPC, TFC and TAC in maize caryopses. Highly compromised expression of morphological, yield contributing and biochemical traits under drought and heat stress were significantly ($P \leq 0.05$) restored by exogenous application of 1 µM Se. Thus, it could be concluded that exogenous Se application could efficiently reduce the drought and heat induced toxic effect on plants and promote desired morphological, biochemical and yield traits to compensate yield loss.

Post-Harvest Shelf Life Prolonging of Cherry Tomato (*Lycopersicon esculentum*) by Edible Coating

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Abstract
Edible coatings using natural biomaterials are being explored as a safer alternative to synthetic antioxidants and preservatives to extend the post-harvest shelf life of perishable food crops and to improve food appearance. Recently, an edible coating based on Aloe veragel has been used to increase the shelf-life of various fruits and vegetables for their storage. The present study was aimed at investigating the effect of Aloe vera gelalone and in combination separately with oil and alginate to increase the shelf-life of cherry tomatoes. The experiment consisted of four post-harvest treatment groups and a control group. The cherry tomatoes were coated with 10% A. vera, 15% A. vera, oil + 15% A. vera, and alginate + 15% A. vera, and after that, the samples were stored at room temperature for 14 days. The biochemical parameters such as vitamin C and lycopene content, TPC, antioxidant properties, TA, pH, color, and firmness of the fruits were examinedonthe 7th and 14th day of storage.The color (l*, a*, b*) of cherry tomatoes did not differ among the treatment groups. Vitamin C and lycopene content decreased for all groupsthroughout the duration. However, those coated with 15% A. vera fruits exhibited the best in decreasing the same. Expectedly, the antioxidant activity was the highest for 15% A. vera treated fruits among all groups. Therefore, I conclude that 15% A. veracoating couldbe considered a promising treatment for prolonging shelf life and maintaining the quality of cherry tomatoes during post-harvest storage.

Assessing Interrelationship among Glycemic Index with Physicochemical Traits of Common Rice Varieties in Bangladesh

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Abstract
Various rice grain qualities could be the determinants of safe consumption, especially for diabetic or non-diabetic individuals. The present investigation was conducted to assess the interrelationship between the glycemic index with the biochemical and cooking properties of six BRRI hybrid rice cultivars, along with their categorization and subsequent relationship. Six biochemical traits such as amylose (by spectrophotometer at 620 nm), protein, moisture and fat content (by Grain analyzer machine), ash, fiber and fat content, morphological traits such as length-breadth ratio and cooking properties, including grain elongation,cooking time, water uptake ratio, gel consistency (based on

rice paste consistency), and alkali spreading test were measured. The result revealed that most of the BRRI hybrid rice cultivars had intermediate class amylose ranging from 20.87% to 24.30% except BRRI hybrid dhan 4 with a low amylose content, 17.23%and had medium Glycemic Index ranging from (56.31 to 63.83) except for BRRI hybrid dhan 4 with high GI (70.89).ACI rice had a low GI of 52.45 as expected. Heera2 had minimum L/B (2.35 mm) and high cooking time (20 minutes). BRRI hybrid dhan 6 had maximum L/B (3.76 mm), low cooking time (16 minutes), and a high alkali spreading value (6.42) and BRRI Hybrid Dhan2 had a low alkali spreading value (3.92), and the rest of the rice varieties exhibited intermediate alkali spreading values. Soft gel consistency was found in BRRI hybrid dhan 3, BRRI hybrid dhan 4, and BRRI hybriddhan 5 and medium gel consistency was found in Heera2, BRRI hybrid dhan 2, and BRRI hybrid dhan 6. The Glycemic index of BRRI hybrid rice varieties showed correlation positively with milled rice length, a length-breadth ratio, gel consistency and also, showed correlation negatively with milled rice breadth, amylose content, cooking time, water uptake ratio, grain elongation and an alkali spreading value.

Evaluation of Nutrient Composition, Phytochemistry, and Pharmacological Potentials of Marine Algae Collected From the Coasts of Bay of Bengal

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Abstract

Seaweed is becoming increasingly popular as food materials due to its essential nutrients and bioactive compounds.Nutrient composition, phytochemical profile, and antioxidantproperty of five macroalgae were examined. The proximate analysis revealed the highest protein (19.99%) and dietary fiber (26.82%) in *Gracilaria tenuistipitata*, crude fat (3.85%) in *Spatoglossumasperum*and ash (14.71%) in *Hypneaboergesenii*. Mineral analysis showedsignificantlyhigher levels of calcium and sodium in *H. boergesenii* (756.924 and 17.62 mg % DM, respectively), potassium in *S. tenerrimum* (523.77 mg% DM), iron in *Enteromorpha intestinalis* (98.27 mg% DM), copper in *S. tenerrimum* (2.24 mg% DM) and zinc in *S. asperum* (1.90 mg% DM).Phytochemical screening confirmed the presence of tannins, saponins, alkaloids, and flavonoids inalgae. Chlorophyll and carotenoidwere highest in *E. intestinalis* **(**1.57 mg/g**)** and *S.asperum*(0.19 mg/g), respectively.DPPH radical scavenging assay indicates that *H.boergesenii* exhibited a moderate antioxidant activity (IC_{50} value, 91.06 ± 6.44µg/mL).Taken together, these resultsindicate that seaweedcould be a rich source of essential nutrients and bioactive compounds with pharmacological potential,suggesting their use as promising functional food.

Improvement of Growth Performance, Antioxidant Status, and Gut Health in Broiler Chickens through Dietary Supplementation of Phytogenic Feed Additives

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Abstract

The injudicious use of antibiotics as growth promoters in poultry ration has attracted a grave concern around the world. Currently, scientists are trying to replace broad-spectrum antibiotics by alternative natural feed additives in animal diets. The current study aimed to investigate the dietary effect of turmeric rhizome and moringa leaf on the growth performance, serum lipid profiles, intestinal microflora and meat quality of broiler chickens. A total of 160 Arbor acres broiler chickens (14 day-old) were randomly distributed into four groups offered with experimental rations designated as T_0 (Control); T_1, Turmeric powder supplementation (0.25%); T_2, Moringa leaf powder supplementation (1.5%), T_3, Mixture of turmeric (0.25%) and moringa leaf powder (1.5%) supplementation. T_3 showed the highest increase in body weight with a relatively lower FCR. Serum levels of cholesterol and LDL-cholesterol also significantly decreased in T_3. T_3 further showed the lowest *E. coli* count. T_3 had the highest meat yield due to high carcass weight and breast muscle weight. Drip loss was significantly reduced in the T2 and T3

groups, where T_3 exhibited a numerical improvement in water holding capacity (WHC) and a reduction in cooking loss, as well as low or similar free fatty acid levels, peroxide value, and thiobarbituric acid reactive substances (TBARS) value. In addition, the total antioxidant capacity of broiler meat significantly increased in all supplemented groups with the highest increase in T_3. However, no significant changes in total phenolic content in broiler meat were observed, but slightly higher values were noted in T_1 and T_3. Together, dietary supplementation of turmeric (0.25%) and moringa leaf power (1.5%) improved growth performance, lipid profiles, gut microbiota and yield, quality, and oxidative stability of meat, suggesting their potential as an alternative mean of growth additives instead of hazardous synthetic antibiotics for safe and organic poultry meat production.

Nutritional, Anti-Nutrientsandantioxidant Activity of Perole (*Vigna Unguiculata* L) Seed Under Customary Processing Techniques

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Abstract

The study was conducted to investigate the effect of traditional cooking process: boiling and pressure cooking on the proximate composition, macro elements and ant-nutrient: phytate, total polyphenol contents of Perole (*Vigna unguiculata* L.) cowpeaseeds. This research showed that heat processing amounted to loss of nutrients; this may be due to leaching during heat application. There was drastic reduction of anti-nutrients content of boiled and pressure cooked peroles and this probably is because the anti-nutrients are heat labile. The Boiled Peroles (BDP) had the lowest values of crude protein (17.46%), crude fat (2.84%) and crude fibre (0.99%) while Pressure Cooked Peroles (PCP) had values of crude protein (20.22%), crude fat (2.94%) and crude fibre (0.91%). There was comparable value of ash content in all the samples except for BDC with the least. The decreasing order of anti-nutrient factors in treated cowpeas is: RWC > PCC > BDC. This result inferred that boiling is an adequate processing for drastic reduction of the anti-nutrient factors (phytate) in perole. Total polyphenol content (TPC) of the pressure cooked & boiled samples significantly ($p \leq 0.05$) decreased but the DPPH scavenging activity in both samples significantly ($p \leq 0.05$) increased. The macro elements composition of perole showed that heat processing amounted to loss of nutrients; this may be due to leaching during heat application. Boiling and pressure cooking had increased the amount of this macro element content when compared with the raw sample. Therefore, it could be concluded that the heat treatments had significantly reduced that anti-nutrient factors in perole. More research should be conducted into ways of reducing anti-nutritional factors, improving in-vitro protein digestibility (IVPD) and improving cowpea proteins.

Nutritional and Functional Properties of Some Indigenous Rice Varieties Cultivated In Haor Areas of Kishoregonj District

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Abstract

An experiment was conducted in department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, Mymensingh-2202, on Seven endogenousrice varieties viz.,Pijam, Lakhaiya, Rata boro, Topa boro, Zira, Kalizira and Katari collected from local field from Tarail and Mithamain haor of Kishoreganj district in Bangladesh and to understand thephysio-chemical (functional) propertiesand proximate composition.It was observed that carbohydrate (76.54%)and amylose contents (28%) were higher in Kataririce whereas,Pijamcontained the highestamount of fat (4.89%)and energy (379.22 kcal/100g). Rata borowas the topper for moisture content (13.67%).Protein (11.12%) and ash contents (4.45%) were higher in Topa boro and crude fiber was the highest amount in Zira (3.03%).The physical analysis revealed that Lakhaiya contained most weight for 1000 grains (17.8g) and highest length calculated (5.25cm). On the other hand, Zira had the highest length/wide ratio (4.28), but

Lakhaiya had the lowest ratio (1.7). Among the functional properties,Kalizira flour was found to hold the highest value of water absorption capacity (203.41%) and emulsion activity (24.88%). Rata boro and Topaboro had shown the highest value for bulk density (0.62g/ml). On the other hand, Rata boro, Lakhaiya and Pijamhad shown the highest swelling capacity (0.96ml/g) andLakhaiyaand Rata borohad shown the highest oil absorption capacity (214.41%) and bulk density respectively.Gelation ofrice flour and protein isolate were best at concentration of 14% (w/v) for all the examined varieties. The above stated resultsof chemical and functional properties may be considered forhealthy and nutritious food preparation at home and others and also in formulation of rice-based products.

Antinutritional- Antioxidant Content and Glycemic Index Value of Some Indigenous Rice Varieties Cultivated In Haor Areas of Kishoregonj District

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Abstract
Both in vitro and in vivo experiment was conducted in the Food Chemistry and Nutrition Laboratory of Department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, from August, 2022 to June 2023. The samples were indigenous rice races viz. Katari, Kalizira, Rata Boro,Lakhaiya,Topa Boro, Pijam and Zira. They were collected through direct contact with the farmers. To calculate the quantity of carbohydrate in each rice proximate analysis was done where Moisture (%), Ash (%), Fiber (%), Fat (%), Protein (%) were determined. It was observed that Katari contained the highest carbohydrate (76.54 %) and Topa Boro was the lowest (67.14%) and Zira was the moderate (71.26%). Based on the popularity, Katari and Zira were selected to observe the glycemic index valuein ten healthy individuals. From the in vivo experiment it was evident that Katari showed the lower glycemic index value (47.80) compared to Ziar (55.34). Antioxidant in terms of Total Phenolic Content (TPC) (µg GAE/mg) was observed for all the collected varieties and Topa Boro contained the highest amount (0.06 µg GAE/mg) and Katari showed the lowest (0.014µg GAE/mg) TPC. On the other hand, for DPPH scavenging activities in terms of antioxidant (%) Topa Boro performed the highest (13.81%) and Kalizirawas the lowest (4.75%), where Katari is the second scorer (9.21%). So, from the above result it is recommended that Katari rice may be considered as low glycemic index and high nutritious rice variety.

Moving to Conservation Agriculture: Evidence of Rhizome Crops Performance in Existing Agroforestry Practices of Madhupur Garh, Bangladesh

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Abstract
The continuous practice of mono-cropping by small-scale farmers in Bangladesh has resulted in poor soil quality and declining crop yields. As a result, there is a growing need to explore sustainable production methods that are resource-efficient and environmentally friendly. Conservation agriculture has emerged as a beneficial approach that effectively addresses these challenges by utilizing locally available resources to enhance crop productivity and soil quality. With this in mind, the objective of this study was to assess the impacts of conservation agricultural practices on the growth and yield of ginger and turmeric in the Madhupur Garh of Bangladesh. The study was conducted in the Auronkhola, Gaira andMakontonagarvillages of Madhupur Garh, using a Randomized Complete Block Design (RCBD) with three replications. Ginger and turmeric were selected for the field experiments. The results showed that these spices exhibited significantly higher yields (6090 kg/ha and 11370 kg/ha, respectively) compared to traditionally cultivated rhizome crops in the farmers' fields. The implementation of conservation agriculture practices contributed to the improved yields. As part of conservation agriculture practices, various factors crucial for crop production, such as soil organic matter content, total nitrogen, phosphorus, potassium levels, and pH, were

positively influenced. This was achieved through the use of organic manure, minimal tillage, the retention of permanent crop residues, and crop rotation. Based on the findings, the study concludes that traditional agriculture must transition to conservation agriculture methods in order to achieve increased food production while utilizing naturalrenewable resources and minimizing negative environmental impacts. This shift towards conservation agriculture offers a more efficient and sustainable approach to farming.

Transforming Traditional into Climate-Friendly Agroforestry Practices for Mitigating Climate Change Impact in Bangladesh

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Abstract
Poor soil quality and decreasing crop yields brought on by ongoing monocropping in the fields of small-scale farmers in Bangladesh have demanded a search for sustainable production methods that are more resource efficient and environmentally friendly. Climate-friendly agroforestry is such a beneficial approach that effectively addresses crop productivity and soil quality enhancements using locally available resources. Therefore, the objective of the study was to determine the impacts of climate-friendly agroforestry practices on the growth and yield of rhizome crops in the Joloi and Gaira villages of Madhupur Garh. The study was executed in the farmers field using Randomized Complete Block Design (RCBD) with three replications in 2022-2023. The trial rhizome crops, i.e. turmeric and ginger showed slightly better yield of 6.09 t/ha and 11.37 t/ha compared to traditionally cultivated rhizome crops in the farmers' fields. According the climate-friendly agroforestry approach had enhanced crop yield, although the yield difference was non-significant but it shows improving trend. As part of climate-friendly agroforestry practices, soil organic matter content, total nitrogen, phosphorus, and potassium levels, as well as p^H for better crop production, were all positively increase with the implications of climate-friendly techniques like, adding organic manure, minimal tillage, permanent crop residues and crop rotation. Therefore, the study came to the conclusion that traditional crop production systems would need to adopt climate-friendly methods in order to produce more crops while using lower natural renewal resources and doing so in a more efficient manner while having the least possible negative effects on the environment.

Light Intensity Effects on the Yield and Quality of Cotton Crops under Different Agroforestry Systems in Charland Area

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Abstract
In Bangladesh, agroforestry is a traditional practice that diversifies agricultural production and enhances natural resource utilization; however, it creates competition for light between trees and understory crops due to heterogeneous spatio-temporal light patterns and can lead to systemic reductions in grain yield. The present study simulated reductions in light intensity caused by trees to examine the effects on cotton yield in an agroforestry system. A two factorial RCBD experiment was conducted with sole cropping and three tree species viz; T_0= cotton sole cropping (control), T_1= mahogany, T_2= mango, T_3= guava and three varieties viz; V_1= Hybrid (White Gold-1), V_2= CDB 12 and V_3= CDB 14. In this system, the first 4 m (13.12 ft) are allocated for trees where three rows of trees are planted with a spacing of 2 m × 2 m. The next 20 m are allocated for crops (Cotton). Reduced light intensity decreased the number of flowers per plant, number of balls per plant, weight of seed cotton per plant, and seed cotton yield. The result revealed that the highest harvested balls was recorded (44.12 balls/plant) in sole cropping with V_1 variety (T_0V_1) whereas it was decreased 4.83%, 9.07%, and 10.14% in T_1V_1(mahogany×hybrid), T_2V_1 (mango×hybrid) and T_3V_1 (guava×hybrid) combination respectively. The maximum seed cotton weight was (169.12 g/plant) measured in T_0V_1 followed by T_1V_1,T_2V_1, and T_3V_1 respectively. Similarly, the highest seed cotton yield was obtained in$T_0V_1$and yield was decreased by 6.09%, 10.51% and 13.37% in T_1V_1,T_2V_1,and T_3V_1 respectively. In agroforestry systems, the seed cotton yield was reducedcompared to the sole cropping due to the

reduced light intensity under the tree rows. However, this reduction was nonsignificant which reveals that this cropping pattern is suitable to minimize the effect of reduced light intensity on crop yield under agroforestry systems.

Agroforestry Models Development and Productivity Evaluation for Sustainable Agricultural Production

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Abstract

This research was conducted in the field laboratory of the Agroforestry department, Bangladesh Agricultural University, Mymensingh to develop sustainable agroforestry models with different fruit and medicinal tree species. Mango, guava, Malta and dragon plant were used as fruit tree species. Amloki, bohera, horitoki and sajna plants were used as medicinal tree species. Different winter vegetables (spinach, radish, mustard, red amaranth, carrot, turnip etc.), summer vegetables (stem amaranth, kangkong, Indian spinach etc.) and annual root crops (turmeric and ginger,) were cultivated with the above fruit and medicinal tree species. During this research period (July 2022 to June 2023) one research experiment was conducted viz. Performance of ginger with different tree species as agroforestry practices. This experiment was conducted following the two factorial Randomized Complete Block Design (RCBD). Factor A: Different tree species viz. Amloki, Horitoki, Bohera, Mango and Malta, Factor B: Distance from tree base Viz., 0 – 50 cm, 51 – 100 cm, 101 – 150 cm and without tree species. Based on the research results it was found that the yield of ginger was highest (18.85 tha^{-1}) under control i.e. without tree combination. Among the different tree combinations highest yield of ginger was recorded in association with amloki tree (14.42 tha^{-1}) followed by Malta (13.85 tha^{-1}), Horitoki (13.65 tha^{-1}), Bohera (13.20 tha^{-1}) and Mango (12.50 tha^{-1}). Average yield reduction (%) of ginger with Amloki, Horitoki, Bohera, Mango and Malta were 23.52, 27.60, 29.97, 33.70 and 26.53 %, respectively. It was also found that the yield of ginger in association with all tree species gradually decreased towards the base of tree. The yield of tree components (fruit and medicinal trees) was not significantly varied with and without ginger combinations but numerically ≤ 5% lower yield was recorded under intercropping conditions. The Land Equivalent Ratio (LER) of these ginger based agroforestry practices ranges as 1.41 – 1.69, which indicates 41-69% yield advantage i.e., under monocultures, 41 - 69% more land would be needed to match yields from this intercropping or agroforestry practices. Benefit Cost Ratio (BCR) analysis also support the LER analysis information which indicates all of these ginger based agroforestry practices are productive. Based on the BCR and LER analysis suitability/productivity of the above ginger based agroforestry practices is ranked as Amloki-ginger > Horitoki-ginger > Bohera-ginger > Malta-ginger > Mango-ginger.

Intercropping of Medicinal Herbs with Medicinal Tree Species as an Agroforestry System for Higher Production and Its Impact on the Environment

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Abstract

This research was conducted in the field laboratory of the Agroforestry department, Bangladesh Agricultural University, Mymensingh to observe the productivity of medicinal herbs under medicinal tree species and its impact on environment. Medicinal tree species are: (i) Amloki (*Phyllanthus embilica*), (ii) Bohera (*Terminalia bellirica*), and (iii) Horitoki (*Terminalia chebula*). All medicinal trees are five years old and well established. Medicinal herbaceous species are (i) Aloe vera, (ii) Kalomegh, and (iii) Shimul mul. In this study, for productivity evaluation

growth and yield performance of both medicinal trees and herbs will be observed and for environmental study soil fertility, tree biomass and carbon stock will be measured. During this study period (July 2022 to June 2023), different research activities- preparation of experimental field, soil sample collection, and measurement of tree biomass and carbon stock were done. A total 72 soil samples were collected by using auger at 0-15 cm and 15-30 cm soil depth from the selected plots. Based on initial research results, it was found that the average height of Amloki, Horitoki and Bohera medicinal tree species are 23.1 ft., 28.65 ft. and 30.61 ft., respectively. The average GBH of Amloki, Horitoki and Bohera tree species are 29.64 cm, 36.43 cm and 48.33 cm respectively. The highest above-ground biomass (33.58 kg/tree) was found at Bohera and the lowest (10.37 kg/tree) was found at Amloki tree. According to the result, the highest total tree biomass (42.32 kg/tree) was estimated from Bohera and the lowest total tree biomass (13.07 kg/tree) at Amloki tree. It was reported that the highest total carbon stock (21.16 kg/tree) was found at Bohera and the second highest total carbon stock (15.29 kg/tree) was found at Horitoki tree species.

Production of High Value Medicinal Plants (Aloe Vera, Ashwagandha, Kalmegh, Shimulmul) in the Existing Agroforestry Systems for Enhancing Farmers' Livelihood in the Charland Area of Bangladesh

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Abstract
Medicinal plants (MPs) are serving as an important source of income to the local communities, including many pharmaceutical and toxicological properties to feed the herbal industry. On-field, four experiments were carried out at Char Kalibari under the Sadar Upazila of Mymensingh from January 2021 to December 2022 to evaluate the performance of four MPs (Kalmegh, Shimulmul, Ashwagandha, and Aloe vera) grown under existing agroforestry systems. Each experiment comprised 12 plots where the selected MPs were individually intercropped under the Mahogany, Mango, and Malta trees, along with a control plot (without a tree) designated as T_0 (control), T_1 (Mahogany), T_2 (Mango), and T_3 (Malta) following RCBD with three replications. The results of Experiment 1 showed that plant height (cm), number of leaves per plant, and leaf area (cm^2) of the Kalmegh plant varied significantly, but no significant variations were found in the yield parameters among the agroforestry systems. The highest plant fresh weight (10967 kg/ha) was obtained at T_3 treatment (Kalmegh+Malta), and the lowest plant fresh weight (9800 kg/ha) was obtained at T0 treatment. According to the results of Experiment-2, root diameter (cm), fresh weight and dry weight of root/plant (g), fresh weight and dry weight of root (kg/ha) of Shimulmul plant did not significantly influence the different tree species. The highest fresh root weight (19731 kg/ha) was recorded from the Shimulmul+Mango combination, whereas the lowest fresh root weight (17313 kg/ha) was recorded from the Shimulmul+Malta combination. The results of Experiment 3 showed that different tree species had no significant effects on the yield performance of the Ashwagandha plant as an agroforestry practice. But numerically, the maximum root fresh weight (545.33 kg/ha) was obtained at the control plot, and the minimum root fresh weight (433.23 kg/ha) was found at the Ashwagandha+Malta combination. The Experiment-4 on Aloe vera cultivation under various agroforestry systems showed that the different MPTs had no significant effects on Aloe vera yield. From the results of each experiment, the MPs performed well under different tree species in an agroforestry situation. Therefore, it can be concluded that the cultivation of medicinal plants under existing agroforestry systems could be a viable approach to increasing farm productivity and upgrading the livelihood of the farmers in the Charland areas of Bangladesh.

The Expression of TaGSK1 and TaNIPgene Indicates Salt Tolerant in Wheat

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Abstract
Wheat is the second most importantcereal crop next to rice. Soil salinity is one of the primary abiotic stress factors that cause significant loss of crop yield. In Bangladesh, about 1.51 Mha of arable lands are affected by varying degrees of salinity. More than 50% of arable land worldwide is predicted to be salt-affected by 2050. A study was

conducted to detect salt tolerance in wheat Germplasm by morph-physiological and Salinity-tolerant gene expression analyses. Twenty wheat genotypes were cultured on 0, 8, 12, and 15 dS/m salinity imposed at 12 days in a hydroponic system. Morphological characters were used to calculate the Stress Tolerance Index (STI). Standard Evaluation System (SES) was used visually. Based on the SES and STI at 15 dS/m salt stress BARI Gom (29), BINA Gom 1, and BWMRI 2 have been identified as salt-tolerant genotypes. Six genotypes were moderately tolerant and rest 11 genotypes were sensitive. Pot culture with three tolerant, two moderately tolerant, and two sensitive genotypes for expression analysis of salinity-tolerant genes has been performed. RT-PCR was used to detect the expression of four salt tolerance genes after salinity treatments. Higher expression of TaGSK1 genes was recorded in BINA Gom-1, BARI-28, BARI-22, and BWMRI-2 and TaNIP gene expression was higher only in BINA Gom-1. This is the first report of TaGSK1 and TaNIP gene expression in any Bangladeshi wheat variety under saline conditions. The output of the study will be valuable for developing saline-tolerant wheat in Bangladesh.

Genetic Audit of Hilsa Shed (*Tenualosa Ilisha*) Across Its Distribution Range

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Abstract

The Hilsa shad (*Tenualosa ilisha*), the flag bearer fish of Bangladesh is the single most important anadromous fish species that contributes 11% of the total fish production of the country. For improvement of hilsa fishery, an efficient management tool needs to be developed by taking its biology, genetics and ecology into consideration. Here genetic differentiation and connectivity between nine different hilsa shad populations namely Chandpur, Goalanda, Hakaluki, Rajshahi, Sundarban, Kuakata, Teknaf populations of Bangladesh and the Arabian Gulf and Shatt al-Arab populations of Iraq were investigated using both morphological and single nucleotide polymorphism (SNP) analyses. Discriminant function analysis from the analysis of 18 morphometric distances showed different clusters of Bangladeshi and Iraq populations suggesting that a substantial level of morphological difference existed between Bangladeshi and Iraqi hilsa. The number of polymorphic sites and haplotypes both in mtDNA cyt b and COI genes found to be higher in Bangladeshi (cyt b: 7-22 and 7-12, respectively and COI: 5-20 and 5-11, respectively) populations compared to the fish of Iraqi populations (cyt b: 0-1 and 1-2, respectively and COI: 2-3 and 4-5, respectively). Additionally one SNP in cyt b gene and three SNPs in COI gene were found to be specific to Bangladeshi and Iraqi hilsa shad. All of these suggested that Bangladeshi hilsa shad were different from those of Iraq. This was further confirmed by genotyping of hilsa of different populations at 11 nuclear DNA SNP loci using high resolution melting analysis. Moreover, it was found that hilsa shad of Iraq populations were genetically alike whereas Bangladeshi hilsa shad collected from different sites were highly heterogeneous. Importantly, the Naf river hilsa specific- SNPs were detected in both cyt b and COI genes at a noticeable frequency. Discover of Bangladesh, Iraq and Naf river hilsa shad specific- mutations could assist in identification of respective hilsa shad by the development of a PCR-based molecular technique using mutagenic primers. The findings of the study could therefore, be useful in management, conservation and protection of hilsa shad of Bangladesh.

DNA Fingerprinting and Genetic Diversity Studies of Litchi (*Litchi Chinensis*) Using Microsatellite DNA Markers

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Abstract

In order to investigate genetic diversity in litchi, a total of eighteen litchi varieties namely China-2, China-3, Bombay, Madraji, Bedana, Golapi, Kathali, Mangalbari, Muzaffarpuri, BARI Litchi-1, BARI Litchi-2, BARI Litchi-3, BARI Litchi-4, BARI Litchi-5, BAU Litchi-1, BAU Litchi-2, BAU Litchi-3 and BAU Litchi-4 were collected and subjected to both morphological and microsatellite DNA analyses. For morphological analysis, a total of eleven traits viz., Leaf length (cm), Leaf width (cm), Leaf area (cm^2), Fruit length (cm), Fruit width (cm), Fruit weight (g),

Seed weight (g), Seed length (cm), Seed width (cm), Flesh weight (g), TSS from 54 genotypes of the eighteen litchi varieties (3×18) were analysed. Varieties varied significantly in eight out of eleven traits consisting of Leaf length, Leaf weight, Leaf area, Fruit width, Fruit length, Fruit weight, Flesh weight and TSS. Fruit and Flesh weights were found to be the highest in Bedana and China-3 varieties. The seed weight ranged from 1.38 to 3.22 with the least recorded in China-3 and the highest in BAU Litchi-3 varieties. On the basis of principal component analysis, out of eleven components, only three principal components (PCs) exhibited more than 1.00 Eigen value and showed about 84.85 % variability among the traits studied. The PC1 had the highest variability (41.84.3%) followed by PC2 (23.74%) and PC3 (19.27%) for traits under study. The contributing traits of first principal component (PC1) were Fruit length, Fruit weight, Fruit width, Flesh weight, Seed length, TSS and seed weight of varities China-3, Bedana, Bombay, Madraji, Golapi and BAU Litchi-1. For microsatellite DNA analysis, genomic DNA from 50 genotypes of 18 litchi varieties were extracted, confirmed and quantified. PCR amplification of alleles at 6 loci of DNA of 50 genotypes were made and confirmed by 2% agarose gel electrophoresis. Allelic separation at these loci through polyacrylamide gel electrophoresis was going on. Genotypic data at 14 microsatellite DNA loci of the eighteen varieties together with the morphological data will be used in evaluation of genetic diversity in litchi of Bangladesh.

Combined Proline and Glycine Betaine reinforce Maize Tolerance to Salt Stress Through Modulation of Growth, Leaf Water Content, Ionic Homeostasis, Stomatal Size and Oxidative Damage

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Abstract
Osmolytes proline (Pro) and glycine betaine (GB) have been reported to impart tolerance against salinity stress in many plants. However, there is no report available on the combined application of Pro and GB on mitigation of salinity-induced growth inhibition of maize. Consequently, the goal of the current study is to assess Pro's and GB's potential as priming and exogenous agents in maize under salt stress. The seeds of maize were germinated under 20 mM Pro and 20 GB conditions, either with or -without 120 mM salinity stress. The findings demonstrated that salt stress lowered maize seedling- characteristics, final germination percentage (FGP), photosynthetic pigments, relative water content (RWC), stomatal size, and K^+/Na^+ ratios. In addition, higher levels of malondialdehyde (MDA) and hydrogen peroxide (H_2O_2) were observed, whereas lower levels of catalase (CAT) and peroxidase (POX) were noted. The priming with Pro or GB or Pro+GB significantly increased FGP, GI, shoot-root biomass, SVI, and reduced mean germination time (MGT) under salt stress. Foliar application of Pro, GB, or Pro+GB to the maize plants resulted in a significant increment in chlorophyll contents, RWC, K^+ absorption, and stomatal size under salt stress. Furthermore, supplementing with Pro, GB, or Pro+GB reduced the accumulation of H_2O_2 and MDA caused by salt and augmented the levels of CAT and POX in the leaves of maize plants. Taken together, the current study's findings indicate that combining Pro and GB is the most effective technique for improving the salinity-tolerant seed germination and seedling traits of maize plants.

GIS-based Approach of Quantifying and Mapping Carbon Sequestration at Bangladesh Agricultural University

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Abstract
The ongoing rapid urbanization will influence the vegetation with huge reduction of green spaces, which eventually enhance emission of Greenhouse gases like CO_2.The purpose of this study is to investigate the amount of carbon sequestration and to construct a carbon stock map within the 32 acres of the World's 2nd largest fruit repository named BAU Germplasm Center (GPC).The methodology involves the steps of calculating the amount of CO_2 sequestered in a tree $year^{-1}$, determining the total (green) weight of the tree, determining the dry weight of the tree,

determining weight of C in the tree, determining weight of CO_2 sequestered in the tree, and finally determining the weight of CO_2 sequestered in the tree year^{-1}. For this study only perennial tree species are considered within the huge area of BAU-GPC. The total tree count is Mango (3820), Areca palm (2570), Weeping debdaru (1782), Guava (1438), Jackfruit (1343), Coconut (1305), Koroi (637), Akashmoni (602) and Mahua (565). The top 10 CO_2 sequestering species are Koroi, Shimul, Ficus, Rubber fig, Debdaru, Teak, Christmass tree, Minjiri, Burlflower and African Mahogony. They are sequestering CO_2 at a rate of 409.47, 338.71, 154.86, 453.82, 327.56, 274.88, 207.39, 250.99, 250.87 and 259.16 pounds year^{-1}, respectively. A couple of carbon stock map has been constructed dividing the whole study areas into several blocks that shows the necessity of conserving perennial tree species in a priority basis. Furthermore, these data will support Carbon Credit under CDM that established under Kyoto Protocol for developed country to mitigate greenhouse gas emission.

Characterization of Dew and Rain Water of Different Regions of Bangladesh-Focusing Pollutants Deposition

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Abstract

Dew is water in the form of droplets that appear on thin exposed objects in the morning or evening due to condensation. Dew water is the result of atmospheric vapour condensing on a substrate that has cooled down because of a radiation deficit. Dew is the product of direct condensation of atmospheric water vapour on the ground, which has fallen below the dew point but not as low as water is freezing point. To explore the properties of dew and rain water and their probable impacts on environmental pollution this study was conducted. The experiment was conducted based on characterization of dew and rain water focusing pollutants deposition in selected regions of Bangladesh. Sampling wasdone manually by locating plastic pots on open air areas (in order to contaminate pollution). Dew collection was made just after the beginning of winter season. The collection of dew samples was taken only on rainless night to eliminate the influence of precipitation. To avoid the effects of haze or rain on the particle concentration of air, all dew water samples were collected before sunrise. Rain water collection wasmade just after the beginning of precipitation events and until it stopped. A total of 90 rain and 90 dew samples (with three replications), were collected. Samples were collected during or immediately after a deposition event. They were stored at a low temperature without chemical preservatives because the analysis was performed in the laboratory.pH, EC, metals (Zn, Pb, Cr, and Cd) were measured accordingly. Rain water and dew water were collected, filtration and laboratory preparation were completed and laboratory analysis is on-going till the end of the project. Few samples were analyzed and the rest of the activities (sample collection and analysis) of different regions are on-going. Based on the obtained data, the mean pH values are found for dew was 7.1 in Mymensingh and 7.19 in Dhaka and for rain 7.13 in Mymensingh and 6.62 in Dhaka. The pH values of dew are higher than that of rain samples. Rain water was slightly more acidic than dew. The mean EC value for dew was 448.2 µS/cm in Mymensingh and 566.2 µS/cm in Dhaka and the EC value for rain were 1022µS/cm in Mymensingh and 739.8µS/cm in Dhaka. The EC values of rain samples are found higher than that of dew samples. The concentration of trace metals ranged in order with Zn> Cr> Cd>Pb and the concentration of Zn found in higher value and exceed theWHO recommended limit and the concentration of Cr and Cd are found below the detection limit and no Pb is found in any sample. The respective analysis supported that the increasing pollution levels have significant influence on the dew and rain water chemistry in Mymensingh and Dhaka city. Further results and their comparison will be focused after completion of the project works.

Mitigation of Carbon Emission through Restoring Degraded Soil Ecosystem around the BSCIC Industrial Area of Mymensingh City Corporation

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Abstract

Industrial activities have been degrading soil ecosystems through discharging harmful wastes and effluents, accelerating carbon emissions which already imposed significant threat to our environment. This research was

undertaken to develop low C emission rice farmingtechnique through restoring degraded soil ecosystems in the vicinity of the Bangladesh Small and Cottage Industries Corporation (BSCIC) industrial area within the Mymensingh City Corporation area.The study employed a multidisciplinary approach such as field surveys, soil and water samples analysis, and conducting on spot field experiment to find out effects of soil amendments and biological agents on soil properties improvement and controlling methane emissions. The experimental treatments wereT1: Control (No NPKS, No soil amendments); T2: Recommended NPKS (100%); T3: NPKS (50%) with Vermicompost (IPNS); T4: NPKS (50%) with Trichocompost (IPNS); T5: NPKS (50%) withAzolla compost and BGA (IPNS); T6: NPKS (50%) with water hyacinth compost (IPNS) and T7: NPKS (50%) with Poultry manure compost (IPNS). Among the amendments poultry manure compost with NPKS (50%) revealed maximum grain yield (5500 kg/ha) and seasonal cumulative methane flux (168 kg ha^{-1}), while water hyacinth with NPKS (50%) showed minimum grain yield (4500 kg/ha) and seasonal cumulative methane flux (181 kg ha^{-1})under the cropping pattern "Boro rice-fallow-T. aman rice".Inclusion of Sesbaniaroshtrata as green manuring crop between the boro and aman rice growing seasons rice grain yield was increased by 8-15%. After two years of experimental period, heavy metals such as Cu, Zn and Cd concentrationswere significantly decreased in vermicompost, azolla compost and water hyacinth amended soils, although Mn concentration was found minimum in trichocompost amended soil.In general, the selected soil amendments decreased heavy metals concentration by 12-17%, reduced total cumulative CH_4 flux by 6-11.0% and improved soil redox status, water pH, DO, TDS, NH_3, NO_3^- and SO_4^{-2} level in degraded soil waternear the BSCIC industrial area.

Heavy Metals and Antibiotics Inaquaculture in Bangladesh: Assessment of Risk to Consumer's Health

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Abstract

This study was conducted to determine the levels of trace elements and to profile associated human health risksin the flesh of cultivated Pangus ((Pangasius pangasius), Rui *(Labeo Rohita), Tilapia* and related fish feeds. Fifteen pangus fish, fifteen rui, 15 Tilapia and thirty fish feeds were collected from individual farms of Trishal in Mymensingh. ICP-MS was used to measure metal concentrations. For pangus, the highest metal pollution index was 3.80 and the highest values were found for As (22.89 mg kg^{-1}), Cr (24.94 mg kg^{-1}), Mn (290.48 mg kg^{-1}), and Pb (8.71 mg kg^{-1}) which surpassed the standard value. Estimated daily intake of As, Cd, Cr, Cu, Ni, Pb, Co was found to be lower except for Cr (1.71), and Pb (0.34), which surpassed the maximum tolerable intake. The non-carcinogenic risk (HQ) was <1 except Ni. Carcinogenic risk values ranged from 10^{-6} to 10^{-4} for As, Cr, Cu, Ni, and Pb, which is considered an acceptable range.Twelve metals were also determined from rui. For feed samples, the higher metal concentration (mg kg^{-1}) was found for Cr (31.007 mgKg^{-1}), Mn (155.06 mgKg^{-1}), Pb (6.65 mgKg^{-1}) and As (134.18 mgKg^{-1}) and all these concentration crossed the standard limit set by WHO.This investigation confirmed significant variations in heavy metal concentrations where all the metals were found below the WHO permissible limit except for Cr and Mn.

Evaluation of Tolerance Index of Plants to Mitigate Air Pollution

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Abstract

This study was conducted to determine the tolerance of plants against air pollution through Air Pollution Tolerance Index (APTI) for the recommendation of suitable plants species for the remediation of air pollution. This study was able to assess how well 29 plant species from different brick kiln locations could deal with elevated levels of air pollution. Several biochemical markers, including total chlorophyll content, pH of the leaf extract, relative water content, and ascorbic acid content, were examined to anticipate the effects of different contaminants on plants. Heavy metal concentrations in the studied plant species were also measured with ICPMS to evaluate their sensitivity

to pollution. The findings of the investigation indicated that *Carica papaya* (APTI 17.80) and *Cassia fistula* (APTI 17.40) demonstrated the highest levels of tolerance, while Annona squamosa (APTI 8.31) exhibited the greatest degree of sensitivity. The efficiency with which metals accumulate was found to be highest in *Artocarpus heterophyllus* (35.84) and lowest in *Syzygiumcumini* (0.63). Total 29 Plants were also collected from Dhaka-Mymensingh highway and the highest APTI value was observed in in Java plum (19.22) and the lowest APTI value was found in White wing (5.64). The highest MAI value was found in Oil Palm (36484.25) and the lowest MAI value was found in Gardenia (208.63).Thirty-four plants were collected from Dhaka city and the highest APTI value was found in Bakul (12.6) and the lowest APTI value was found in Mehogani tree (5.06). In terms of Phylloremediation, 11 plant samples from the roadsides of Mymensingh city were examined where Bokul, Jam, Need and Mehedi Plant contained the highest number of strains. The study recommends the plantation of roadside plant species with higher tolerance in Dhaka and Mymensingh City, as they can serve as effective biomonitors for assessing environmental pollutants in the city.

Phytoremediation and Phylloremediation Approach: Exploring the Potential of Plants for the Remediation of Air Pollutants in Urban Areas

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Abstract
Certain plants can be chosen as biomonitoring agents, with the most tolerant playing a crucial role in alleviating air pollution by acting as a sink for gaseous pollutants. Conversely, sensitive plant species can serve as bio-indicators of air pollution. This study was designed to assess the sensitivity and tolerance of plant species to air pollution, which involved the collection of leaves from traffic areas of Dhaka city and roadside areas in Mymensingh. A total of 50 common plant samples were examined to assess their tolerance to air pollution and metal accumulation capacity using the Air Pollution Tolerance Index (APTI) and Metal Accumulation Index (MAI). Collected samples were investigated for different biochemical parameters, including total chlorophyll content, ascorbic acid levels, leaf extract pH, and relative water content, whereas dried samples were investigated for the presence of heavy metals using ICP-MS after digestion with HNO_3 and H_2O_2. The concentration of $PM_{2.5}$, PM_{10} and CO were measured and the highest concentrations were observed in Bridge more and Charpara.Based on the APTI values of Dhaka city traffic areas, Bakul (APTI 12.60) and Litchi (APTI 12.51) were the most tolerant, and Mehogani (APTI 5.06) was the most sensitive. Whereas the MAI of plants from traffic areas in Dhaka city was observed to be highest in Bakul (2.53) and lowest in Litchi (0.27). APTI values of plants in the roadsides of Mymensingh city revealed that Jamm (APTI 19.23), Krishnachura (APTI 14.50), and Neem (APTI 14.19) exhibited the most tolerance, whereas Musanda (APTI 5.64) exhibited the most sensitivity. Palm oil showed the highest MAI value (5.173), and Gandharaj had the lowest MAI value (0.322) among the studied plants in Mymensingh city. In terms of Phylloremediation, 11 plant samples from the roadsides of Mymensingh city were examined where Bokul, Jam, Need and Mehedi Plant contained the highest number of strains. The study recommends the plantation of roadside plant species with higher tolerance in Dhaka and Mymensingh City, as they can serve as effective biomonitors for assessing environmental pollutants in the city.

Seasoning of the Bangladeshi Timber Species and Sustainable Development

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Abstract
This study was conducted to investigate theseasoning of some selected Bangladeshitimber speciesand sustainable development.By the investigation it was seen that the sequence of tensile strength like as, Sundari > Sal > Jackfruit > Kewra.The shrinkage orders of timber species are: Keora>Sal >Kanthal>Sundari at longitudinal direction; Sundari>Sal>Kanthal>Keora at radial direction; Sal>Sundari>Keora>Kanthal at tangential direction.The

hygroscopicity of heat-treated wood was varied with the degree of crystallinity (DoC). Increase in degree of crystallinity cause the degree of hygroscopicity and vice versa.Degree of crystallinity (DoC) is observed increases after heat treatment on Sundari and Sal. Therefore, DoC remains almost same for Kanthal and reduced slightly for Keora after heat treatment observed.The DoC of untreated timbers canbe sorted as Kanthal>Keora> Sundari > Sal. The DoC result provides valuable insights into the structural properties of samples, aiding in the understanding of material behavior and facilitating the design of materials with tailored properties.The DoC of treated timber can be sorted as Keora> Sundari >Sal >Kanthal. The DoC can significantly influence material properties, including mechanical strength, optical properties, thermal behavior, and chemical reactivity.Kanthal and Sal is more acceptable for structural uses in outer weather and the others may be used for indoor purposeswhere moisture content is almost controlled.The timber dimension changes higher in both radial and tangential direction where in longitudinal its marginal.Different dielectrics of these species tells us that they have different capacity for storing energy.Dielectric properties of Sundary is relatively higher than those of other species. This means fiber density and tensile strength is relatively higher in Sundary than those other three species. High dielectric constant indicate that the material is highly insulating.Materials that have negative dielectric loss are used in high frequency range. Because, negative dielectric loss mitigates the electrical power loss.However, particle board prepared by us is cheaper, denser and more uniform than conventional wood and plywood.

CHAPTER III
Faculty of Animal Husbandry

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Explore the Role of Low Density Lipoprotein (LDL) on Motility, Viability and Plasma Membrane Integrity of Short Term Preserved Spermatozoa of Indigenous Sheep in Bangladesh

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Abstract
Indigenous sheep is still being neglected in Bangladesh and very little attention has been paid for their improvement. Dilution of semen with extender contains whole egg yolk results in loss of sperm motility, viability, and plasma membrane integrity affecting its quality. Recently, attempts have been made to replace the whole egg yolk in bull, dog and boar semen extender by low-density lipoproteins (LDL). Therefore, the present study was conducted to explore the role of LDL on motility, viability and plasma membrane integrity in short term preserved spermatozoa of indigenous sheep in Bangladesh. For this, protocol for the isolation of LDL from chicken egg has been developed. Thereafter, semen was collected from three mature indigenous rams. The average semen volume raged from 0.50±0.01 to 0.60±0.06 ml, sperm concentration 3165.00±97.00 to 3356.67±52.06 milion/ml, progressive motility 72.14±1.41 to 74.84±1.71% and live spermatozoa 80.01±1.24 to 80.98±0.84% in fresh semen. Semen aliquots were diluted with egg yolk-citrate diluter where whole egg yolk was only used in control group (with 20% egg yolk in diluter), and 8% LDL, 10% LDL were used as replacement of whole egg yolk in the diluter. Diluted semen was then preserved for five days at 4^{o} C. It was observed that preserved sperm motility was significantly ($p<0.05$) higher in 8% LDL group than control group through the 10% LDL group showed insignificantly ($p>0.05$) lower that 8% LDL group. Viability and plasma membrane integrity also showed the same trend. Semen preservation quality was remained significantly ($p<0.05$) better in 8% LDL group than control group. So, these results suggested that the effective level of LDL for short term preserved spermatozoa is 8% in indigenous sheep and the protective action of egg yolk in the diluter is largely due to low-density lipoproteins (LDL) in indigenous sheep of Bangladesh.

Semen Production Profile and Seminal Characteristics of Fresh and Short Term Preserved Spermatozoa of Indigenous Aseel Chicken in Bangladesh

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Abstract
This study aims to examine the seminal attributes of fresh and short term preserved spermatozoa (at 4^{o}C) of indigenous Aseel chicken in Bangladesh. Abdomen massaging technique was used for collecting semen from three adult Aseel chicken at three days interval and microscopically inspected for semen quality. Semen volume, sperm concentration, motility, live, and morphologically abnormal spermatozoa of fresh semen varied from 0.18±0.05 to 0.20±0.04 ml, 3.24±0.31 to 3.56±0.26 × 10^{9}/ml, 75.39±2.33 to 79.04±2.08%, 74.44±2.59 to 79.52±1.73% and 17.07±2.23 to 20.78±3.12%, respectively. Then semen was diluted with Egg Yolk-Citrate (EYC) diluter and preserved at 4°C. Thereafter they were examined at different preservation periods such as Day 0 (0 h), Day 1 (24 h), Day 2 (48 h), Day 3 (72 hr), Day 4 (96 hr) and Day 5 (120 hr). The findings of the study indicated that as preservation time progressed, sperm motility, live spermatozoa, and normal spermatozoa percentage were gradually declined. Total motility percentage significantly ($p<0.05$) decreased with the passage of time in case of all individual cock. Progressive motility percentage was significantly ($p<0.05$) decreased from Day 0 (57.4±3.21) to Day 5 (0.11±3.21). On the contrary, non-motile sperm percentage significantly increased in Day 5 (99.3±4.85) compared to Day 1 (21.9±4.85). On the other hand, live spermatozoa was significantly ($p<0.05$) higher (76.68±5.06%) on Day 0 (0 h) and gradually declined day after day and finally it was 0% on day 5 (120 h). On the contrary, spermatozoa abnormalities were highest at Day 5 (11.29±1.69 % head, 3.33±1.42% mid-piece and 7.26±1.66% tail) and head abnormalities were significantly ($p<0.05$) affected by the hours of preservation. This study suggested that semen quality of Aseel chicken significantly affected by the hours of preservation and remain good upto 2 days which could be used for AI.

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Development of Meat Type Crossbred Using Boer and Black Bengal Goat

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Abstract
This study was conducted to assess the growth performance of Boer × Black Bengal (BB) F_1 goats and to identify genetic and non-genetic factors affecting growth under extensive rearing system of Bangladesh. Three purebred Boer bucks in the Bangladesh Agricultural University station were used to breed BB does in the nearby communities to produce F_1 crossbreds. Live weight records until 12 months of age along with some other relevant information were kept. The average least square means of birth weight, weight at 1-, 3-, 6- and 12-months were observed as 1.76±.06, 4.13±.15, 8.94±.31, 13.81±.53 and 23.23±1.00 and 1.81±.07, 4.02±.15, 8.41±.35, 13.06±.51 and 26.51±.75 kg in male and female, respectively having insignificant sex difference ($p<.05$). ADG1 (birth-weaning) and ADG2 (weaning-six month) were found as 54.13±2.65 and 54.30±2.89 and 47.41±3.00 and 51.08±4.58 g/d in male and female, respectively. Both ADG did not differ ($p>.05$) between sexes. Sire, region, birth type, dam's parity and season of birth, birth type×kid sex and birth type×birth season impacted growth traits mostly in the earlier stages. Season of birth ($p<.001$) and its interaction with birth type ($p<.05$) affected 12-months body weight. Dam parity ($p<.05$) and birth type ($p<.001$) influenced ADG1 and sire ($p<.05$) and season of birth ($p<.05$) influenced ADG2. Only 5% of the F_1 does manifested behavioural oestrus within 1 year of age but the cause of delayed oestrus is not explored. Boer×BB F_1 crossbreds gained more than two times higher live weight than BB goats (compared with published values) under similar extensive management and environment. Since dams are BB, therefore, litter size remains unaffected. It suggests that goat farmers in Bangladesh can have more than two times higher benefit by producing this type of crossbreds. As sex of the kids does not affect body weight and body weight gain, so animals of both sexes may be recommended for slaughter without further breeding.

Modulatory Effect of Curcumin on Bovine Oocyte Competence under Endotoxin Exposure

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Abstract
Mammalian oocytes are vulnerable to various external factors such as infections and endotoxins, which can significantly affect their developmental competence. This study delves into the potential of curcumin, a bioactive compound, to alleviate the adverse effects of lipopolysaccharide (LPS) on bovine oocyte maturation and gene expression. A total of 507 oocytes were collected and subjected to in vitro maturation (IVM) across four experimental groups: control, LPS, Curcumin, and LPS+Curcumin. Morphological parameters and Brilliant Cresyl Blue (BCB) staining were employed to evaluate oocyte developmental competence. Gene expression analysis unveiled intricate molecular responses influencing oocyte growth and competence. At the MII stage, the LPS group exhibited diminished oocyte diameter and cumulus expansion, suggestive of impaired maturation. Conversely, curcumin-treated oocytes displayed larger diameters and enhanced cumulus expansion, indicating a protective effect against LPS-induced damage. These findings were corroborated by BCB staining, underscoring curcumin's potential in maintaining oocyte developmental competence in the presence of LPS. Gene expression analysis revealed significant downregulation of ACOX1, an energy regulation gene, in the LPS group, while its expression remained unchanged in the LPS+Curcumin group, implying curcumin's role in preserving energy homeostasis. Apoptosis-related genes CASP8 and BAX exhibited heightened expression in the LPS+Curcumin group, potentially influencing oocyte competence and development. Moreover, the stress response gene CHOP displayed increased expression across all groups, with an additional effect observed in the LPS+Curcumin group, indicating potential impacts on oocyte health. Lipid metabolism-related genes FASN and PPARA exhibited dynamic responses, with curcumin mitigating LPS-induced downregulation, which could impact lipid utilization critical for oocyte quality. Epigenetic regulators DPPA3 and PADI6 showed downregulation across all groups, with curcumin exacerbating this

effect, potentially influencing cellular differentiation and oocyte competence. In conclusion, curcumin demonstrates protective effects against LPS-induced damage during bovine oocyte maturation, influencing gene expression related to energy metabolism, apoptosis, stress responses, lipid metabolism, and epigenetic regulation

Genetic Evaluation of Different Graded Holstein Friesian×Local (HF×L) Crossbred Breeding Bulls of Bangladesh

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Abstract
The aim of this study was to estimate genetic parameters, breeding value and ranking of Holstein Friesian×Local (HF×L) crossbred sires based on multi-trait selection index information. A total of 51 HF×L crossbred breeding bulls of three different genetic groups (50%HF×50%L, 62.5%HF×37.5%L and 75%HF×25%L) managed at Central Cattle Breeding and Dairy Farm (CCBDF) were evaluated based on 4319 half-sib progeny performance data. The descriptive statistical analysis was performed using R platform while heritability (h^2), genetic correlations and breeding values were estimated using BLUPF90 program by single trait animal model. Three different selection indices were constructed using adjusted breeding values multiplied by variable economic weightage for each trait. Genotype had significant effects on the investigated semen quality attributes (P<0.05) where 75%HF×25%L and 62.5%HF×37.5%L crossbred genotypes both differed significantly with 50%HF×50%L crossbred bulls (P>0.05). In general, better productive and reproductive performances were found with the progression of exotic HF inheritance. Daughters of 75%HF×25%L crossbred bulls showed highest average performance in birth weight (27.20±0.09 kg), daily milk yield (8.55±0.06 liter), peak milk yield (10.44±0.07 liter), lactation length (233.53±0.85 days), age at first conception (19.66±0.07 months), days open (101.13±0.66 days) and calving interval (12.97±0.04 months) except service per conception (1.60±0.01). The heritability estimates were found low to moderate and the corresponding values for the studied traits were 0.16±0.04, 0.27±0.05, 0.24±0.04, 0.26±0.05, 0.17±0.04, 0.17±0.04, 0.32±0.04 and 0.09±0.04, respectively. Genetic correlations among the considered traits were found mostly weak. The constructed three selection indices showed almost equal efficacy in bull ranking except two individuals and rank order of top 20% breeding bulls remained almost same in position among the three tested index models. This study provides relevant information of individual bulls that could be the basis for proven crossbred breeding bulls' selection process at CCBDF.

Evaluation of Performances of Pekin × Nageswari Crossbred Duck for Growth and Egg Production Traits

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Abstract
This study was conducted to evaluate growth performance and egg production potentials of purebred Pekin (P), Nageswari (N) and the resultant P×N crossbreds up to 4th generations. Data on growth, production, reproduction, feed intake and disease incidence were collected from F_3 and F_4 generations. In addition, previously collected data of foundation stock (P and N), F_1 and F_2 generations were incorporated in genetic evaluation process. Growth performance differed significantly (P<0.01) among the parental Pekin, Nageswari and crossbred ducks from day-old to 20th weeks of age. The average live weight of Nageswari was 1367±17.38g at 12th week of age whereas the average live weight at the same age in birds of four crossbred (P×N) generations was 1703.02±19.76, 1910.46±18.81, 1826.49±20.63 and 1837.14±13.96 g, respectively, which was almost similar to the pure Pekin duck (1908.26±34.18g). Positive hybrid vigor was observed in all four crossbred generations (F_1 to F_4) for growth traits up to 12th week of age except day old weight. Differences in hen day egg production (HDEP%) were significant (P<0.01) among the genotypes up to 40th week of age except 28th week where non-significant differences were observed. Importantly, the egg production performance of four crossbred populations differed insignificantly in most

cases with their parental Pekin and Nageswari ducks. The laying curves from onset of laying to 40th week of age were almost similar and consistent among the four crossbred duck populations. Crossbred ducks laid medium sized eggs as compared to their parental breeds Pekin (highest) and Nageswari (lowest) populations. This result reflects the significance of non-additive genetic effects only on growth traits. In conclusion, the growth and egg production performances of P×N crossbred duck were established through evaluation of successive generations data. This valuable genetic resource could be utilized at farmers level for production of more meat and egg.

Detection of Polymorphisms in FASN, DGAT1 and PPARGC1A Genes and Their Association with Milk Composition Traits in River Buffalo of Bangladesh

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Abstarct

Buffalo milk has specific physiochemical and taste characteristics which contains higher fat, protein, lactose, vitamin and mineral as compared to cow's milk. Previous studies reported candidate genes polymorphisms and their associations with buffalo milk composition, more particularly with milk fat, protein and solids not fat (SNF). The objectives of this study were to investigate polymorphisms in three candidate genes (FASN, DGAT1 and PPARGC1A) and their possible association with milk fat and protein contents in river buffalo of Bangladesh. Phenotypic database on milk production and milk composition related traits were established through Herdbook based record keeping system. Phenotypic data collection and blood sampling were performed from 242 lactating animals from six different locations namely Jamalpur, Pabna, Rajshahi, Bagerhat, Laxmipur and Dhaka. Milk composition data (milk fat, protein and SNF) were generated using a portable Lactoscan milk analyzer. One or two fragments of these three well annotated candidate genes were selected for polymorphism screening and subsequent association studies. Multiple sequence analysis revealed 11 single nucleotide polymorphisms (SNPs) in the exons and UTRs of three candidate genes. Among them, two SNPs were identified in the FASN gene (g.7163G>A and g.7271C>T), two were in DGAT1 gene (g.7809C>T and g.8525C>T) and the remaining seven SNPs were in PPARGC1A gene (g.387642T>C, g.387714G>A, g.387758A>G, g.387966A>T, g.409354A>G, g.409452G>A and g.409614C>T). Association analysis revealed that the g.7271C>T SNP of FASN gene had highly significant association with milk fat and SNF ($P<0.01$). The g.8525C>T SNP of DGAT1 gene had highly significant association with protein content of the investigated buffalo milk samples ($P<0.01$). Moreover, the g.387758A>G and g.409354A>G SNPs of PPARGC1A gene had significant association with protein ($P<0.01$) and SNF ($P<0.05$), protein ($P<0.001$), SNF ($P<0.01$) and lactation length ($P<0.05$), respectively. In conclusion, the identified significantly associated SNPs could be used as potential molecular marker(s) for improving milk composition traits in river buffalo of Bangladesh upon validation of the results with large number of samples.

Development of Animal Recording and Genetic Evaluation System to Foster Indigenous Buffalo Selection Program

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Abstract

The buffaloes of Bangladesh are mainly low producing indigenous type encompassing both swamp and river type and their crosses with Murrah, Nili-Ravi and Mediterranean. While implementing a field-based buffalo breeding program, development of on-farm animal recording system (individual animal ID, pedigree and performance data), continuous use of thus generated data to estimate genetic parameters and development of a dynamic genetic evaluation system to facilitate purebred animal selection are the keys of success therein. This project aimed to investigate on-farm buffalo recording system with regards to evaluate growth, reproduction, milk yield, milk

composition and diseases incidence in indigenous buffaloes under the prevailing systems of their management. Farmers who own river type indigenous buffalo(es) were identified from Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka; Godagari, Rajshahi; Ishwardi, Pabna and Madarganj, Jamalpur. From the household farmers potential mature Indigenous female buffaloes were individually identified, registered and all information were recorded in Herdbooks. Records included both pedigree (sire and dam identity, if available) and performance (body weights, growth, reproduction, milk yield and composition, incidence of diseases etc.) on each indigenous buffalo. The data were recorded by Trained Animal Recorders in each project sites/areas. The buffalo owners were trained on improved methods of feeding, breeding, management and healthcare practices. The quality of collected data was checked with highest possible attention. The recorded data were manually entered into the computer using Microsoft Excel sheets. Data on a total of only 101 Indigenous mature female buffaloes (22 from Jamalpur, 33 from Pabna, 8 from BLRI and 38 from Rajshahi) were collected and used for preliminary analysis. Pedigree of all animals with exception of only 5 animals from BLRI were unknown mainly due to the absence of animal recording system. The horn length (cm), heart girth (cm), body length (cm), wither height (cm), rump height (cm) and mature body weight (kg) of Indigenous, Murrah and their crossbreds were respectively 39.14±1.52 (73), 35.66±1.33 (35), and 35.52±1.26 (87) cm; 180.63±0.90 (73), 192.37±1.47(35) and 191.78±1.11(88) cm ; 143.03±0.58(73), 113.06±2.50 (35) and 141.42±1.02 (88) cm; 92.62±2.17(73),136.06±0.81(35) and 132.31±0.61 (88) cm; 104.58±1.32 (73), 130.23±0.91(35) and 115.32±1.05(88) cm and 422.78±4.81(73), 377.37±7.90 (35) and 472.83±7.55(89) kg. These morphometric parameters differed ($P<0.05$) among the Indigenous, Murrah and their crossbred buffaloes. Similar significant differences among the morphometric parameters were observed among location (Jamuna river basin-Jamalpur, Padma river basin-Pabna, Rajshahi, Southern part- Bagerhat, Raipur, Noakhali and Central part-BLRI) and management (farm and farmers). The average body condition score of Indigenous buffaloes were 3.50 ±0.03(83), parity ranged from 1-7, horn length of 39.49±1.56(73) inches, birth weight of 35.03± 1.31(30) kg, black coat colored, heart girth of 180.78±0.92(73) inches, body length of 143.18±0.60(73) inches, wither height of 92.73±2.20(73) inches, rump height of 104.64±1.34(73) inches, body weight of 428.26±10.10(47) kg, postpartum heat at 84.69±3.31(32) days, service per conception of 1.00±0.00(32), calving interval of 388.13±3.24(32) days, daily milk yield of 3.00± 0.06(101) kg, peak daily yield of 3.99±0.08(33) kg, fat content of 8.59±0.18(89)%, protein content of 3.83±0.06(89) % and SNF content of 9.50 ± 0.12(89) % were observed. With time the database are being heavier with all expected information necessary for genetic parameter estimation and genetic evaluation for which computer software of Variance Component Estimation (VCE) by Groeneveld (1998) and Prediction and Estimation (PEST) of Groeneveld et al (1990) respectively are being tested. The breeding value will be estimated for the first lactation average daily milk yield at the beginning and traits such as age at puberty, weight at puberty and average daily milk yield. Those buffaloes with high index EBV for the said traits will be selected for replacement in the original herd for genetic improvement. The genetic evaluation system thus developed will be made public through a website on national indigenous buffalo breeding program.

Red Chittagong Cattle Conservation and Development Program

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Abstract

The Red Chittagong Cattle (RCC) is a national resource which deserves long-term conservation and development for the benefit of the peoples of Bangladesh. The main objective of this research project was to continue the 2004-initiated USDA funded (2004-2008) RCC conservation and development. The donor agency suggested to make the project sustainable for the benefit of the poor farmers of the country and hence efforts were made to find long-term partners for the project to run in a farmer-participatory mode. Along the quest World Vision Bangladesh became the valued, proud, dependable and long-term partner of a "Community Driven Livelihood program with Red Chittagong Cattle" for the benefit of the rural cattle keepers of a village near BAU. Livelihood of the rural farmers through the conservation and utilization of the valued Red Chittagong Cattle of Bangladesh was in the heart of the said community driven program. This program was able to generate income for the poor farmers as well conserving the valuable RCC for the future generations to come. A farmer cooperative was formed and scientific methodology for record keeping, application of preferential mating design through artificial insemination with the semen of selected pure Red Chittagong bulls (maintained at BAU AI Centre) was continued for years. Capacity building of the farmers, AI with pure RCC bull semen, milk collection, marketing, distribution of fodder cutting, annual deworming

and vaccination of farmers' cattle were strictly followed. Farmers' day, cattle show, certification of farmers' cattle based on their genetic merit and similar other income generating and awareness raising innovative activities were included in the program. The Community Based RCC Society was established as source of pure seed RCC in the country. Most meritorious breeding bulls produced in this society was procured to the BAU AI Centre for preparation and semen collection for use in the farmers herds. Non-descript Local cows/heifers were being bred with RCC semen produced at the BAU AI Centre since 2004 and graded RCC progeny produced in the vicinity villages of BAU which generated a population of various grades of RCC. The carried out research also provided insight information on genomic diversity and population structure of RCC. The whole genome sequence of four RCC samples were done using Illumina NGS technology and the NGS data are awaiting analyses. In different batches a total of twenty-six potential pure young RCC bulls with known pedigree were identified in the Chittagong district, purchased and brought to BAU AI Centre for routine recording of their body weight, growth, testicular measurement and semen characteristics. Meanwhile, after test results a total of 16 (sixteen) Certified RCC bulls have already been dispatched for use to American Dairy Ltd. (ADL), Lal Teer Ltd., ACI Genetics Ltd., IDF and Momota, Chottogram, Desha, Kushtia, a private owner of Dinajpur and Ejab Alliance Ltd., Thakurgaon. Moreover, RCC research generated sufficient scientific evidence, population and breed descriptor data meanwhile with which an application for registration of RCC to the national body was filed and has declared (24.5.2022) RCC as a dual-purpose native breed of cattle of Bangladesh. A 20-year journey of the RCC project has addressed the need of poor farmers to help save their very unique, valuable and world reputed indigenous cattle resource "Red Chittagong Cattle". This creature has already become a pathway of farmers livelihood as it possesses many useful attributes including easily identifiable, small in size, an average milk yield of 3 kg per day (with a range of 2.5 to 8.50 kg milk per day) very little eater, happy with straw based diet, high disease resistance, gives one calf every year, very tasty milk and meat, very high market demand and suits well with the low-input management system of smallholder rural farmers of the country. Extra certified bulls and heifers were sold to the interested organizations, companies and NGOs for use in farming. Upon satisfaction of the results of this project the Department of Livestock Services (DLS), Government of Bangladesh has developed a herd of pure RCC herd at Hathazari, Chittagong and started keeping breeding bulls to produce semen for artificial insemination of RCC cows at greater Chittagong district since 2006. Bangladesh Livestock Research Institute (BLRI) also has taken up two phases of national RCC conservation and development program. Most importantly, RCC conservation and development has been placed in the Cattle Breeding Policy of the National Livestock Development Program (NLDP, 2007) and thereafter RCC semen is being produced and used by government Department of Livestock Services (DLS) as well as all other cattle breeding service providers of Bangladesh since 2008 and thus RCC conservation and development is on move in this country indicating a clear achievement of this project.

Molecular Characterization, Conservation and Utilization of BAU Black and White Crossbred Duck for Better Meat Production

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Abstract

The objectives of the study were to evaluate production potentials of Pekin (P) × Nageswari (N) crossbreds and their genetic characterization using microsatellite (MS) markers. A nucleus flock of 5th generation has been maintained at BAU Artificial Insemination center and all sorts of data on growth, production and reproduction have been recorded as par objectives of the project. Besides, a total of 132 blood samples were collected from the parental P, N and their P × N crossbreds in order to investigate genetic diversity measures, population structure, genetic distance and phylogenetic analysis. Microsatellite genotyping was performed using 14 selected polymorphic MS markers distributed across the chicken genome (8 chromosomes). In addition, genotyped data of 44 ducks from three Bangladeshi duck populations (Nondescript Deshi, Jinding and Rupali) were included in the MS marker-based study. The average observed and expected heterozygosity, mean number of alleles and polymorphic information content was found to be 0.59±0.02, 0.64±0.02, 5.44±0.31and 1.28±0.05, respectively in the studied populations. The estimated overall fixation index across the loci (F) was 0.09±0.03. Analysis of molecular variance revealed 84.0% of the total genetic diversity was accounted for within population variation and the remaining 16.0% was incurred with population differentiation (F_{ST}). The principal coordinate analysis displayed 65.42% and 18.27% of the total variations in PCoA1 and PCoA2, respectively. Conservation through utilization of this genetic resource has been

practiced through implementation of this project. Further, the MS based findings provide some important insight on genetic diversity measures and population structure that could support BAU Black and White as a distinct genetic group.

Refinement of Oocyte Collection Technique and Culture Method for *In Vitro* Production of Goat Embryos

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Abstract

In vitro embryo production (IVEP) is an important assisted reproductive biotechnology which has enormous potential for speeding up the improvement of genetics in livestock. The success of IVEP is closely related to ovarian follicular development and oocyte quality. This study was designed to investigate the impact of age on the follicular dynamics of goat ovaries and optimization of IVEP. A total of 40 ovaries of Black Bengal goats were obtained from a local slaughterhouse and sorted into four age groups: 6-12 months, 13-15 months, 18-21 months, and 22-24 months. Subsequently, the ovaries were treated, and follicles were assessed through visually and histologically. For IVEP, total 442 Cumulus Oocyte Complexes (COCs) were retrieved from 178 slaughterhouse ovaries from 18-21 months aged group animal aseptically by the techniques of aspiration and slashing and then collected COCs were graded according to the compactness of cumulus cells around the oocytes. Then *in vitro* maturation, fertilization and culture of graded COCs was done at 38.5°C in a humidified atmosphere of 6% O2, 5.5% CO2 and 88% N2. Histologically, the number of normal primordial and primary follicles was also insignificantly higher ($p>0.05$) in goats aged 18-21 months compared to the other age groups. Conversely, the quantity of secondary follicles significantly increased ($p<0.05$) with age, but in terms of antral follicles, a quadratic trend was observed, where they increased up to a certain age and then declined. Additionally, the results showed that the number of degenerated primary and antral follicles was significantly higher ($p<0.05$) in the ovaries of 22–24-month-old goats, while the number of degenerated secondary follicles was insignificantly higher ($p>0.05$) in goats aged 18-21 months compared to the remaining age groups. In case of IVEP, the number of oocytes recovered per ovary (2.89±0.22) and the percentage of excellent oocytes (grade A: 29.84±4.00 and grade B: 44.80± 2.32) were significantly higher in slashing technique than that of aspiration (2.16±0.31 and 11.80±0.61, 30.80±3.56) technique. After maturation, it was observed that significantly higher ($P < 0.05$) rate of Grade A and Grade B COCs reaching to the M II stage. The cleavage rate of presumptive zygote was found 74.15±6.80 after fertilization and the highest blastocyst rate of presumed zygotes found in this experiment was 37.50%. This study inferred that age had an effect on the follicular dynamics of goat ovaries, suggesting that ovaries from goats aged 18-21 months, sourced from slaughterhouses, hold potential for quality follicles and oocytes. This study also revealed that the slashing technique is more suitable for harvesting the higher number and superior quality of COCs and the culture condition used in this experiment was found to be optimized as it efficiently supports IVM, IVF and subsequent development of goat embryos.

Production and Characterization of Biochar and Bio-oil from Layer and Broiler Litter

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Abstract

This study was conducted to characterize the biochar and bio-oil produced from layer and broiler litter through pyrolysis. Pyrolysis is a process of anaerobic heating of biomasses where biomass is converted into high-value products such as biooil, syngas and biochar. For this purpose, a reactor was designed for the pyrolysis of poultry litters (layer and broiler). Result showed that 33 and 35% biochar was produced from broiler and layer litter respectively at 600 °C temperature. The size of the micropore of layer and broiler litter biochar was observed 7.4 and 7.5 nm respectively, under the scanning electron microscope (SEM). The FTIR value of layer and broiler litter biochar ranged between 430-1384 and 416-1083 wavenumber cm^{-1} position, respectively. Bio-oil production was found 21 and 20% respectively from layer and broiler litter. A higher gross calorific value was found in bio-oil

obtained from broiler litter (11000 kcal/kg) compared to bio-oil obtained from layer litter (10551 kcal/kg). The density of produced bio-oil from layer and broiler litter was very closed (1.2636 and 1.2634 g/cc, respectively). It may be concluded that poultry manure is a good source of biochar and bio-oil that might be helpful to increase soil fertility and for the supplementation of renewable bio-energy.

Ensilage of Rice Straw with Market fish Wastes for the Preparation of Cattle Feed

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Abstract
The research was intended to produce cattle feed with wet rice straw processed with market fish wastes (MFW) and fermented with 5% molasses to enhance the storage quality and nutrients of rice straw. Feeds were placed in plastic drums and sealed properly. The preparation was completed under room temperature following T0 (0% MFW), T1 (5% MFW), T2 (10% MFW), and T3 (15% MFW) to examine the physical qualities, metabolizable Energy (ME), in vitro organic matter digestibility (OMD) and other nutritional properties, at different intervals (0, 30, 45, and 60 days). The organoleptic and physical characteristics (smell, color, and hardness) of feeds were improved in treatments with market fish wastes up to 60 days but after 45 days, in T3, fungi and some bad smells were obtained. The pH, dry matter (DM), crude fiber (CF) were reduced and the crude protein (CP), ether extract (EE), ash, ME, OMD were elevated significantly with MFW and ensiling time ($P<0.05$). Comparing the parameters, T2 and T3 were preferable to prepare silages as cattle feed. Finally, it can be summed up that market fish waste is a valuable resource for the preservation of rice straw which provides farmers with cheap and environmentally friendly cattle feed.

Low-cost Cattle Feed Production by Ensiling Rice Straw, Poultry Droppings and Alovera Leaves

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Abstract
An experiment was conducted with Rice straw (RS) and Aloevera leaves Waste (ALW) treated with poultry droppings (PD) and ensiled with molasses to increase the nutritional and preservation quality of rice straw. Chopped Rice straw T_0(94.9%), T_1(84.9%), T_2(74.9%), T_3(64.9%) in addition to Aloevera leaves Waste (0.1%) were preserved in plastic containers under airtight condition at room temperature based on the treatments as T_0 (0% PD), T_1 (10% PD), T_2 (20% PD) and T_3 (30% PD) with 5% molasses as DM basis in each treatment to investigate physical quality, chemical composition, *in vitro* organic matter digestibility (IVOMD) and Metabolizable Energy (ME) content at 0, 30, 45 and 60 days. The physical quality (color, smell, and hardness) of Rice straw and ALW mixer were improved in PD added treatments till 60 days of ensiling. The Crude protein CP content was increased significantly ($P<0.05$) with both increasing the level of PD and ensiling time for 45 days. The pH value was decreased ($P<0.05$) with the increasing of PD and ensiling time. The CP and ash was increased ($P<0.05$) and dry matter (DM), crude fiber (CF) and ether extract (EE) were decreased ($P<0.05$) in all the treatments (T_1, T_2 and T_3) compared to control one T_0. The EE contents were not significantly different ($p>0.05$) between T_2 and T_3. The CF content was decreased ($P<0.05$) with the increase of PD and ensiling time. The organic matter digestibility (OMD) and metabolizable energy (ME) content were increased ($P<0.05$) with the PD level and ensiling time. Considering all the physical and chemical properties, among all the treatments, T_2 upto 60 days and T_3upto 45 days were acceptable for preparing wastelage.

The Ability of Near Infrared Spectroscopy Coupled with Deep Learning to Predict the Adulteration in Chevon and Mutton

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Abstract
The aim of this study was to test the ability of near infrared (NIR) reflectance spectroscopy to predict the adulteration in chevon and mutton. In total 16 samples were prepared among these two samples were pure and 14 samples were adulterated. For detection of adulteration spectra were collected using DLPNIRscanNano Software. Partial least square and principal component regression model for calibration and validation were developed for detection of adulteration through The Unscrambler X software. Accuracies of the calibration models were evaluated using the root mean square error of calibration (RMSEc), root mean square error of cross validation (RMSEcv), coefficient of calibration (R^2_c) and coefficient of cross validation (R^2_{cv}). Generally, the accuracy (i.e. the closeness between actual and the predicted values) of regression model is considered as excellent when the $R^2 \geq 0.90$. PLSR and PCR models can well predict the adulteration of mutton with chevon with or without the mathematical treatment of NIRS values. Both MVA and deep learning algorithms can able to predict the adulteration. In case of deep learning, CNN with bi-LSTM model shows prediction accuracy 0.856. The results demonstrated that NIR spectral data combined with multivariate and deep learning can predict adulteration of chevon with mutton.

Standardization of Aging and Frozen Storage Time for the Betterment of Local Chicken Meat Consumers

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Abstract
The present research was undertaken to validate ageing and frozen storage durations for the betterment of local chicken meat consumers. Two individual experiments were carried out to establish this. 40 *desi* chicken carcasses with similar weight were assigned into 0 h, 24 h, 72 h and 120 h postmortem ageing time at 4°C chilling conditions to confirm their effective ageing time. Another 40 *desi* chicken carcasses with similar weight were randomly preserved at −18°C for 1 d, 7 d, 14 d and 21 d to identify their appropriate frozen storage duration. pH, cooking loss, water-holding capacity, shear force value, CIE L*, a* and b* value were assessed as physicochemical parameters, Malondialdehyde levels as lipid peroxidation and total coliform count as microbial characteristics of breast muscle in *desi* chicken. For the first experiment, a significant decrease in pH and shear force values were observed as compared to freshly cut breast muscle. Cooking loss percentage was improved with the advancement of ageing of skeletal muscle. Meat color especially luminosity index (L*) reduced as their counterpart. Lipid peroxidation levels were increased with advancing ageing of meat. TCC (lo cfu/g) values show decreasing trend throughout the ageing period. Three days of ageing showed better results in terms of eating quality of meat. In the case of second experiment, no significant changes in pH values were seen after a stipulated periods of frozen storage (1, 7, 14 & 21 days). L* values, water-holding capacity and tenderness of meat were improved following the frozen periods. MDA levels were increased with such frozen durations. TCC values decreases with the advancement of frozen periods. Most notable changes of those parameters were seen after 7 days of freezing times. In conclusion, this research demonstrated that 72 hrs of ageing at normal refrigerator improves all the essential parameters of eating quality of *desi* chicken's breast meat and those meats shows relatively better quality under frozen storage (−18°C) environment upto seven days compared to the others.

Investigation of Yield Characteristics of Pakchong Fodder Using Struvite Containing Compost Compared with Chemical Fertilizer

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Abstract
Struvite containing compost produced from layer litter is a rich source of nitrogen, phosphorus and other micronutrients. The performance of pakchong fodder was studied by utilizing struvite containing compost to identify its application rate on fodder growth. For this purpose, a field study of packchong fodder growth was undertaken in the fodder production area at goat, sheep and horse farm of BAU. A total five treatments such as T_0 (no compost and no chemical fertilizer at all), T_1 (4 ton struvite containing compost/ha), T_2 (6 ton struvite containing compost/ha), T_3 (8 ton struvite containing compost/ha) and T_4 (250 kg urea/ha and other macro & micro nutrients) with three replications were studied. Parameters studied were yield, height and circumference of pakchong fodder along with its nutrient content such as dry matter, crude protein, crude fiber, ether extract, pH, phosphorus and potassium content. The result showed that T_2 produced significant higher yield (96.67 tons/ha), plant height (257.67 cm) and stem circumference (6.63 cm) compared to other treatments. In case of nutrient content, a significant higher CP (15.07%), EE (6.78%), ash (1.77%), P (0.28%) and K (0.98%) contents were found in T_2 treatment also, compared to other treatments. Higher CP and P content in the produced pakchong fodder might be due to nitrogen and phosphorus assimilation from struvite. Therefore, it might be concluded from the experiment that six ton/ha (T_2) struvite containing compost will be the suitable application rate for pakchong fodder growth.

Prediction of Shelf Life of Frozen Beef and Goat Liver for Human Consumption: A Safety Aspect

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Abstract
Protein and fat oxidation are key factors that influence the quality of bovine liver in storage condition. The aim of the present study is to investigate the effect of long-term frozen storage (upto 15th months) on the nutritional and microbiological quality as well as prediction of the shelf life of frozen cattle and goat liver. Proximate components (DM, CP, EE, Ash), sensory parameters (colour, flavor, juiciness, tenderness), color indices L* (lightness), a* (redness) and b* (yellowness), pH, water-holding capacity (WHC), thiobarbituric-acid-reactive substances (TBARS), microbial profile (TVC) were measured at fresh and 6, 9, 12, 15-months frozen duration. Bovine (cattle and goat) liver quality parameters were significantly (p<0.05) altered by 15th months frozen storage during, causing an increase in DM, colour indices (b* yellowness values), TBARS (mg MA/kg), TVC (log CFU/g), and a decrease in CP, EE, sensory parameters, pH, WHC, and colour indices (L* lightness and a* redness values). In terms of standard limit of the quality and spoilage parameters of meat and meat products cattle and goat liver could be stored frozen for one year and remain safe for human consumption but up to 15th month is not acceptable for human consumption.

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Early Pregnancy Diagnosis through Expression of Pregnancy Related Genes in Cattle and Goats

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Abstract

Early pregnancy diagnosis is important for calving interval by allowing farmers to identify open animals for treatment and/or rebreeding. The IFNT can be used as an indicator of pregnancy in cattle because they are present in the blood of mammals. The aim of the present study was expression of *ISG15, MX1* and *MX2* genes at early stage of pregnancy in cattle and goat. In experiment 1, blood samples were taken from the jugular vein of does on 20th, 26th, 30th, 34th and 40th days following natural mating of Black Bengal does and also from three non-inseminated does as control animals. Total RNA was extracted and cDNA was synthesized. The expression profile of *ISG15*, *MX1* and *MX2* genes were then analyzed using qPCR and the reference gene (*β-actin*) was used as internal control for normalization of qPCR. The relative expression values of the qPCR result were calculated using the $2^{-\Delta\Delta Ct}$ analysis method. The results showed that *ISG15, MX1* and *MX2* mRNA expression in the blood were significantly (P<0.05) increased at day 30th in consistent with the level of expression at day 20th, 26th, 34th and 40th after natural mating. For both the *MX1* and *MX2* gene, the expression levels did not differ significantly among days 20th, 26th, 34th and 40th after mating and also in non-inseminated goats. For the *ISG15* gene, the expression level at 34th day was higher than 20th, 26th and 40th after mating and also in non-inseminated goats. The ultrasonography results also support the pregnancy of goats done at later stage. In experiment 2, blood samples were taken from the jugular vein of female cattle on 15th, 20th, 25th, 30th and 35th days following natural mating of cattle and also from three non-inseminated cows as control animals. Total RNA extraction and cDNA synthesis were performed. The expression profile of *ISG15, MX1* and *MX2* genes were then analyzed using qPCR and the reference gene (*β-actin*) was used as internal control for normalization of qPCR. The relative expression values of the qPCR result were calculated using the $2^{-\Delta\Delta Ct}$ analysis method. The results showed that the mRNA expression of *ISG15* and *MX1* genes were increased at day 15th, 30th and 35th in consistent with the level of expression at day 20th, 25th after natural mating and also from non-inseminated cattle. The mRNA expression level of *MX2* was significantly higher (P<0.05) at day 15th, 25th, 30th and 35th than day 20th and non-inseminated cattle. So, the results indicate that expression of *ISG15, MX1* and *MX2* genes can be utilized to detect the pregnancy in cattle and goats.

Influence of Maternal Dietary Energy and Protein Levels during Gestation on Performance of Black Bengal Does and Kids

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Abstract

The study was aimed to know the effect of maternal dietary energy and protein levels during gestation on performance of Black Bengal does and their kids. Goats were randomly allocated to nine treatments groups. The diets containing 3 different levels of metabolizable energy i.e., low, medium, high energy (8.67, 10.4, 11.73 MJ/Kg DM, respectively) and 3 different levels of proteins i.e., low, medium, high protein (10%,14% and 18%, respectively) were randomly assigned to stall-fed 63 pregnant Black Bengal does. Live weight, milk yield, lactation length, blood metabolites, duration of post-partum anestrous of does and birth weight, live weight gain, weaning weight, carcass characteristics of their kids were recorded. At the age of 6 months, the male kids were slaughtered to study carcass parameters. Total RNA was extracted from longissimus muscle and cDNA was synthesized. The expression profile of *Myf5*, *H-FABP* and *MSTN* gene were then analyzed using qPCR and the reference gene (*β-actin*) was used for normalization of qPCR. The relative expression values of the qPCR result were calculated using the $2^{-\Delta\Delta Ct}$ analysis method. All data were subjected to (3×3) factorial and significance of difference among mean was determined by the Duncan's Multiple Range Test (DMRT). The live weight gain and milk yield of does, serum glucose, serum total

protein (TP), albumin and globulin level were significantly ($p<0.05$) higher in high energy and high protein (Hh) group than others. Lactation length was also higher in high energy and high protein (Hh) group although the values did not differ significantly. Post-partum anestrous was significantly ($p<0.05$) lower in medium energy and low protein (Mh) group and higher in low energy and low protein (Ll) group than others. The birth weight, live weight gain, weaning weight of kids, the relative mRNA expression of *Myf5* gene were significantly ($p<0.05$) higher in high energy and high protein (Hh) group than others. The relative expression of mRNA of *H-FABP* gene was significantly ($p<0.05$) higher in medium energy and high protein (Mh) group of kids. The relative mRNA expression of *MSTN* gene was significantly ($p<0.05$) higher in low energy and medium protein (Lm) group of kids than other group of kids. The body length, heart girth, length of neck, neck circumference, carcass weight, dressing percentage (45.8%), rib-eye area of kids, weight of gut, gut fill, empty gut, skin weight and also different edible by products e.g. head, pluck, heart, spleen, liver, kidney and lung+trachea weight were significantly higher ($p<0.05$) in kids of high energy and high protein (Hh) consumed mothers. In conclusion, dietary energy and protein at pregnancy positively influence the live weight changes, milk yield, lactation length and blood metabolites and reduced duration of post-partum anestrous of does and also positively influenced birth weight, growth rate, weaning weight, carcass parameters and expression of *Myf5* and *H-FABP* genes and negatively influenced *MSTN* gene expression of kids.

Influence of Dietary Protein Levels during Late Pregnancy on Performances of Black Bengal Does and Their Kids

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Abstract

The experiment was designed to know the effect of different levels of dietary protein at late pregnancy on performances of Black Bengal does and their kids. Twelve does were divided into three groups having four in each and three diets i.e., low protein (10% CP), medium protein (14% CP) and high protein (18% CP) were supplied. All three diets were isocaloric (10.0 MJ/kg DM). The duration of the experiment was 50 days. During the experimental period the live weights of does were measured. Milk yield, lactation length, duration of post-partum anestrus of does and birth weight, growth rate of kids, body measurements (heart girth, height at wither and body length), survival rates of kids were also recorded. At the end of the experiment, three male kids from each group were slaughtered and carcass characteristics as well as nutrient composition of the longissimus muscle were measured. All data were subjected to one way ANOVA and the significance of difference among means was determined by Duncan's Multiple Range Test. Live weight gain was significantly ($p<0.05$) higher in high protein fed dams than other groups during pregnancy. Milk yield of does was significantly ($p<0.05$) higher in high protein consumed does than the low protein group. Lactation length of does was significantly ($p<0.05$) higher in the high and medium protein fed does than the low protein consumed does. Duration of post-partum anestrus of does was significantly ($p<0.05$) higher in the low protein fed dams than the high protein group. The birth weight of kids was higher in high protein fed does although the values did not differ significantly among the treatment groups. Weaning weight, final weight, live weight gain and average daily gain of kids were significantly ($p<0.05$) higher in kids of the high protein fed does than the low protein group. The average body length of kids at 28^{th} week was significantly ($p<0.05$) higher in kids of high and medium protein consumed does than low group. Average heart girth and wither height at 28^{th} week was significantly ($p<0.05$) higher in high protein fed does than the low protein fed does. Survival rate of kid was higher in the high protein consumed does than others. Hot carcass weight and ether extract content of meat were significantly ($p<0.05$) higher in the high protein group than others whereas dressing percentage was significantly ($p<0.05$) higher in the high protein group than low group. In conclusion, high protein diet enhanced the growth and lactation performance of does and growth rate, hot carcass weight, dressing percentage and fat content of meat of kids.

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Impact of Creep Feeding on Productive Responses in Black Bengal Goats

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Abstarct
The aim of this study was to investigate the effect of different levels of dietary energy and protein at pre-weaning stage on growth, blood parameters, carcass characteristics and expression of genes related to growth and carcass parameters in Black Bangal kids. The experiment was conducted in the Bhaluka upazilla and Animal Science Laboratory under the Department of Animal Science, Bangladesh Agricultural University, Mymensingh. The diets containing 3 different levels of metabolizable energy i.e., low (8.67 MJ/Kg DM), medium (10.4 MJ/Kg DM) and high (11.73 MJ/Kg DM) and 3 different levels of protein i.e., low (14%), medium (18%) and high (22%) were randomly assigned to 90 Black Bengal kids for 3 months. Each group contains ten kids of one month old. Live weight of kids was recorded on a weekly basis. At six months of age, kids (n=27) were sacrificed to study the carcass parameters. The longissimus muscle samples (LM) were grinded by using TissueLyser II machine according to the manufacturer's protocol. Total RNA was extracted from the muscle and cDNA was synthesized. The expression profile of *MSTN* and *H-FABP* genes were then analyzed using qPCR and the reference gene (*β-actin*) was used for normalization of qPCR. The relative expression values of the qPCR result were calculated using the $2^{-\Delta\Delta Ct}$ analysis method. All data were subjected to 3×3 factorial and the significance of difference among means was determined by the Duncan's Multiple Range Test (DMRT). The results of the present study showed that the final live weight, total live weight gain, body length, thigh circumference, Carcass weight (5.67 kg) and dressing percentage (45.75 %) of kids were significantly higher ($p<0.05$) in high energy and medium protein (Hm) consumed kids than others. Higher caul fat and lower gut fill were found in high energy and high protein (Hh) consumed kids than others. The relative mRNA expression of *MSTN* gene known as growth inhibitor, was significantly ($p<0.05$) lower in high energy and medium protein (Hm) consumed group than others. Expression of *H-FABP* gene known as a regulator of marbling, was significantly ($p<0.05$) higher in high energy and medium protein (Hm) consumed group than others. In conclusion, high (11.73 MJ/kg DM) energy and medium (18%) protein (Hm) during pre-weaning stage influences growth performance, carcass characteristics, meat production and meat quality of Black Bengal kids.

Standardization of Estrus Synchronization Techniques for Improvement of Reproductive Efficiency of Native Buffaloes in Bangladesh

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Abstract
This study was aimed to increase reproductive efficiencies of native buffaloes using estrus synchronization technique. In experiment 1, a total of 42 buffalo cows were selected at Madarganj Upazilla, Jamalpur for estrus synchronization to examine the effect of season. Buffaloes were synchronized with Ovsynch protocol. In this protocol, buffaloes were injected 5 ml Gonadorelin (GnRH) (50 mcg; ACI limited) on day 0, 5 ml Dinoprost (PGF2α), KP (5 mg; ACI limited) on day 7 and the second Gonadorelin injection was given on day 9, and artificial insemination (AI) was performed with frozen semen prepared by Bangladesh Livestock Research Institute (BLRI) at 16 hours after final dose of Gonadorelin injection. Blood samples were collected from jugular vein of the buffaloes one month after the treatment for analysis of total protein, albumin, cholesterol, glucose, triglyceride, alanine amino transferase test (ALT), aspartate transferase (AST) and alkaline phosphatase (ALP). All buffaloes showed estrus in breeding season which was significantly ($P<0.05$) higher than non-breeding season (86.67%). On the other hand, 90.91% buffaloes conceived successfully in breeding season where as 73.33% conceived in non-breeding season but the values also did not differ significantly ($P>0.05$). Glucose and total protein (TP) levels were significantly ($P<0.05$) higher in the breeding season than in the non-breeding season. Levels of TG, Cholesterol, ALT, AST, ALP were higher in the breeding season than in the non-breeding season but the values did not differ significantly. In

experiment 2, a total of 59 female native buffaloes were selected at Madarganj upazilla under Jamalapur district to examine the effect of mineral supplementation. Then, 10 gm DCP plus (opsonin pharma) was offered daily to 18 buffaloes and a number of 20 buffaloes were examined as non-treated control group and others (21 buffaloes) were used for estrus synchronization with ovsynch protocol. All buffaloes were offered 1 kg concentrate feed mixture (60 % maize crushed + 40 % wheat bran) daily. Blood was collected one month after the treatment from jugular vein for analysis of glucose, total protein, albumin, TG, cholesterol, ALT, AST, ALP to know the nutritional status. Estrus rate was significantly ($P<0.05$) higher in mineral supplemented (83.33%) and GnRH treated buffaloes (91.67%) than the control group (35%). Conception rates were significantly ($P<0.05$) higher in mineral supplemented (70.83%) and GnRH treated buffaloes (83.33%) than the control group (30%). Calving rates were also significantly ($P<0.05$) higher in mineral supplemented group (65.83%) and estrus synchronized buffaloes (77.78%) than the control group (30% buffaloes). Glucose, albumin, TG and cholesterol levels were significantly ($P<0.05$) higher in the mineral supplemented and estrous synchronized group than the control group. In experiment 3, the buffalo cows (n=42) of second to fifth parity with good body condition score were selected for estrus synchronization at Companiganj, Noakhali. Buffaloes were randomly assigned into one of the three different groups i.e., group 1(n=13), group 2(n=21) and group 3(n=8). Buffaloes of group 1(n=13), group 2(n=21) and group 3(n=8) were inseminated at 16, 20 and 24 hours after administration of second dose of GnRH, respectively. The results showed that conception rates were higher in group 1 (83.33%) than group 2(74.17%) and group 3(53.33%). In conclusion, reproductive efficiencies of estrus synchronized native buffaloes were influenced by season, blood metabolites, mineral supplementation and the time of insemination followed by second dose of GnRH treatment.

Development of Sustainable Garole Sheep Farming through Innovative Approaches of Feeding and Management to Increase Productivity in Bangladesh

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Abstract

This Garole sheep is the latest sensations in the world of domestic species by virtue of its prolificacy, lambing frequency, disease resistance and other extraordinary merits rarely or not even observed in other sheep breeds of the world. The sheep Garole is very popular for its bi-annual lambing, high prolificacy rate, high mothering instincts, adaptability to marsh saline as well as hot and humid climatic condition, grazing on aquatic weeds and grass in knee-dip water and resistance to some common diseases. The proposed research work was to develop cost-effective feed formula for increasing the productive and reproductive performances of Garole sheep. For this purpose, a total of 12 Garole ewe was allocated randomly into three treatment groups (T_0, T_1 and T_2) having four in each for the experiment. Group T_0 was offered as farmers feeding. The concentrate mixture was offered to two different groups (T_1 = CP, 16.3, and ME (Kcal/kg DM) 2638 and T_2 =CP, 18.2 and ME (Kcal/kg DM) 2436) on the basis of protein and energy combination according to NRC (2007). Feed intake, digestibility, birth weight, litter size, weaning weight, age at sexual maturity, post-partum heat period, gestation length, lambing interval, age at first lambing, growth rate, were investigated. Total dry matter (DM) intake (g/d) was found 517.6, 542.9 and 578.5 in T_0, T_1 and T_2, respectively. DMI (% of LW) was 4.06, 4.20 and 4.35 in T_0, T_1 and T_2, respectively. Crude protein (CP) and metabolizable energy intake (g/d) were 40.31 and 4.33, 63.54 and 5.98 and 80.45 and 6.36 in T_0, T_1 and T_2, respectively. DM and CP digestibility were 56.96 and 65.24, 69.27 and 77.33 and 68.95 and 79.66, in T_0, T_1 and T_2, respectively. Protein (CPI/LWG) and Energy (MJMEI/LWG) conversion efficiency were 3.75 and 0.403, 3.4 and 0.319 and 2.98 and 0.236 in T_0, T_1 and T_2, respectively. Daily gain (g) was found 10.74, 18.74 and 26.96 in T_0, T_1 and T_2, respectively. FCR (DMI/LWG) was recorded 48.19, 28.97 and 21.46 in T_0, T_1 and T_2, respectively. Days required for 1 kg LW gain was 93.11, 53.36 and 37.09 in T_0, T_1 and T_2, respectively. Average birth weight (kg), litter size and weaning weight (kg) were found 1.0, 1.25 and 4.0, 1.4, 1.75 and 5.0 and 1.6, 2.0 and 5.88 in T_0, T_1 and T_2, respectively. Age at sexual maturity (m), post-partum heat period (m) and gestation length (m) were 8.0, 2.0 and 5.0, 7.25, 2.0 and 5.0 and 6.5, 1.5 and 5.0 in T_0, T_1 and T_2, respectively. The lambing interval (m) and age at first lambing (m) were 7.5 and 13.0, 7.0 and 12.5 and 6.5 and 12.0 in T_0, T_1 and T_2, respectively. The findings of the research study revealed that, T_2 feeding group was found always better compared with T_0 and T_1. The information's obtained from this study can be used for future development of Garole husbandry in Bangladesh. Thus, Garole sheep farming need to be popularized in Bangladesh as a means of alternative nutritious diet and source of rural family income thereby assisting in the alleviation of poverty.

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Ammonia Gas Emisson from Open Barn Dairy Farm in Bangladesh

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Abstract

Ammonia emissions compose significant environmental pollution, which is related to agriculture, particularly with Livestock production. The highest ammonia emissions of 75% derived from livestock production in dependence of livestock housing buildings, manure storage and so forth. In today's livestock husbandry, difference occurs in housing system, floor type and manure collection and manure storage system. Ammonia emissions levels for cubicle houses are higher than for tie stalls. The purpose of this study was to make an analytical inventory of ammonia emission from an open house dairy farm practiced flushing for manure management twice in a day based on the levels of ammonia gas emission at different times of the day and to find a way for the reduction of ammonia emission. For the assessment of ammonia gas emissions from the open house, the Internet of All (IoA), IoT solutions for all (https://internet-of-all.com/index.php) was used. The IoT is a system of interrelated computing devices with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In addition, ammonia fluxes were also measured using the novel chamber-based technique. A five days continuous data were recorded. It was found that the peak ammonia emissions were recorded between 3 and 7 pm every day. It might result from the combination of manure and urine during water flushing. When exposed by flushing, manure and urine have higher ammonia concentrations than at other times. In a different standpoint, it was found that ammonia emission was higher almost two times when cow dung and urine was combined specially during flushing. Nonetheless, the ammonia gas emission level was within the acceptable threshold. Since most people can detect ammonia between 0.04 and 20 ppm, according to The American Association of Railroads. Threshold is between 5 and 50 ppm.

Effect of Low Temperature Hydrothermal Pretreatment on Fiber Fractions, Organic Carbon and Nutrient Content of Dairy Manure

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Abstract

Low temperature hydrothermal pretreatment technology has been utilized now a days in waste management. Hydrothermal processing is a thermochemical conversion process that degrades biomass into small components in water at high temperatures and pressures. Hydrothermal pretreatment assists in reducing the bulk or volume, water content and increasing the surface area of the fresh cow dung biomass. The purpose of this research was to find the suitability of hydrothermal pretreatment technique in handling a large amount of cowdung in an environmentally friendly way and to decrease the time required for composting cowdung in conventional ways. Fresh cow dung samples were collected from a dairy farm and processed at 150 to 180 °C for 15 to 20 minutes through a screw elevator. The pretreated samples were kept for 24 hours for cooling and the samples were analyzed. Dry Matter, Ash CF, ADF, NDF, Cellulose, hemicellulose, lignin, organic carbon, Nitrogen, Phosphorus, Potassium, and Sulfur content were assessed according to the standard protocols. Dry matter content of pretreated cow dung (23.17 ± 0.16) was significantly higher than fresh (15.92 ± 0.36). However, fresh cow dung was shown significantly higher organic carbon (35.30 ± 0.35) compared to treated cowdung (29.06 ± 0.12). The content of CF, ADF, NDF, ADL, Cellulose, Hemicellulose and Lignin all were influenced by the hydrothermal pretreatment applied in the cowdung. The correlation coefficients between NDF and OC were also notably high: 0.962 with a strong positive significance. Moreover, phosphorus content in the treated cow dung showed a slight increase of 0.61 ± 0.06 compared to fresh 0.49 ± 0.05 but the N, P and S content showed almost constant values. Finally, it is considered that hydrothermal pretreatment to be a promising approach for minimizing nutrient loss, fiber content, and organic carbon of fresh cow dung thus help in decreasing composting time.

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Study on Economic Fodder Production for Dairy Cattle in Selected Area of Bangladesh

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Abstract
The study was conducted at Patiya upazila under Chattogram district of Bangladesh to assess the peri-urban feeding system of crossbred, Red Chittagong Cattle (RCC) and Non Descriptive Desi (NDD) dairy cattle and the interaction between genetic merit and feeding system on milk yield, nutritional status, reproductive performance, profitability and constraint. The findings demonstrated that German grass is fed to HF crossbred cow in stalls. Both RCC and NDD are raised in a "stall and grazing system" using Bermuda grass as their primary food source. RCC and NDD had similar body weights ($P<0.05$), but HF crossbreeds has higher, which were 205.83, 206.13 and 378.55 kg, respectively. Crossbreed, RCC, and NDD cows produced 10.04, 2.57, and 2.67 kg of milk per day, respectively ($P>0.05$). However, the milk yield of RCC and NDD were insignificantly different ($P>0.05$). HF crossbreeds had the best feed conversion ratio (DMI/MY) (1.63), whereas NDD had the worst (1.60) ($P<0.05$). Daily total dry matter intake of a HF crossbreed, RCC and NDD from roughages and concentrate were 15.85, 9.51 and 9.96 kg, respectively. Age at sexual maturity differed substantially ($P<0.05$), and in HF crossbreds, RCC, and NDD, it was 664.6, 968.8, and 754.6 days, respectively. In HF crossbred, RCC, and NDD, the service per conception was 2.19, 1.42, and 1.38 times, respectively ($P<0.05$). Crossbred, RCC, and NDD cows had inconsistent lactation periods ($P<0.05$) of 271, 250, and 229 days, respectively, and significant ($P<0.05$) calf birth weights of 32, 16 and 16 kg respectively. The benefit cost ratio (BCR) of rearing HF crossbred, RCC and NDD were 1.31, 1.17 and 1.17, respectively. In order to raise dairy cows in a peri-urban area, constraints such as feed availability, lactation length, and conception rate were discovered. So, when compared to the conventional feeding and management system, Holstein crossbred cows produced more milk with improved reproductive effectiveness and return.

Improving Nutritive Value of Low Quality Agro-Industrial By-Products by Anaerobic Fermentation with Rumen Liquor for Use as Poultry Feed

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Abstract
Rice bran (RB) and Wheat bran (WB) are the most abundant and cheap agricultural by-products used as poultry feed in many developing countries. However, their use in poultry feed is limited due to the high fiber, low protein content. The objective of the present study is to develop a method for finding optimum fermentation condition to improve their nutritive value by decreasing fiber and improving protein content and quality. Two kinds of bran, RB (De oiled) and WB was used in this study. Fermentation was conducted with rumen liquor by maintaining an appropriate environment for different duration (12h, 24h, 48h and 72h). Diluted rumen liquor (RL) of 50% and 100% was used for both RB and WB in case of all the duration of fermentation. McDougall 1948 buffer solution was added for maintaining the pH. Fermentation was started with pH nearly 7 for both 50% and 100% RL. For pH, it was found that pH reduced significantly ($p<0.05$) with increasing fermentation time for both RB and WB. Up to 24h, pH remained good enough for microbes. However, after 48h and 72h, pH reduced to a level that is harmful for fiber degrading microorganism. In case of crude protein (CP), we found that no significant ($p>0.05$) changes were occurred but increased little bit. For fibre, it was found that all the fibre components decreased significantly ($p<0.05$) after fermentation with increasing fermentation time for both RB and WB. From 12 to 48h fibre decreased gradually significantly but no significant difference found between 48 and 72h. Amino acid profiles of fermented RB and WB significantly increased that would increase the quality of the feed for poultry. Other nutritional changes also occurred in the fermented bran that could be beneficial for poultry. So, it might be concluded that fermented bran could be better option in case of poultry compared to using unfermented bran.

Efficacy of Feeding Improved Quality Shrimp Meal on Broilers Performance, Nutrient Digestibility and Meat Quality

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Abstract
This study aimed to replace soybean meal (SBM) with improved quality shrimp waste meal (SWM) in broiler diets without compromising performance, nutrient digestibility, and meat quality. To improve the nutritional quality, SWM was treated with formic acid (5.0%), and it was observed that chitin content was decreased, whereas CP content and digestibility (*in vitro*) increased in treated SWM. For the *in vivo* trial, a total of 120 Indian River chicks were randomly distributed into five groups with three replications and reared for a period of 35 days. A corn-soybean meal-based basal diet was supplied in the control group, the other four dietary groups contained formic acid-treated SWM by replacing 25%, 50%, 75%, and 100% SBM used in the control diet. Body weight gain (BWG) of birds fed SWM by replacing 25% SBM was comparable with the control group. However, BWG decreased ($p < 0.05$) linearly with the increased percentage of SWM in the diet. Feed intake and FCR in birds fed a control diet and a 25% SBM-replaced diet were almost similar, which decreased linearly ($p < 0.05$) with the increased percentage of SWM in diets. Dry matter digestibility and nitrogen retention in birds given treated SWM by replacing 25% SBM were comparable with the control group; the digestibility decreased with the increasing percentage of SWM. The influence of experimental diets on meat color was found to be irregular, but the decreasing ($p > 0.05$) trend of meat fat content with the increasing percentage of dietary SWM was noticeable. In conclusion, it may be possible to improve the nutritional quality of SWM by formic acid treatment and replace SBM partially in broiler diets with improved quality SWM. However, further investigation is necessary to ensure the replacement percentage without any negative effects on performance or meat quality in broilers.

Improving Nutritional Quality of Agricultural By-products for Sustainable Animal Protein Production

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Abstract
Rice bran and wheat bran are very cheap and abundant agricultural by-products in rice and wheat producing countries. Additionally, many developing countries used these by products as poultry feed. RB & WB contain high fiber and poultry is not capable to digest those fibrous feed effectively, resulting in low performance. Fermentation of bran with rumen liquor leads to desirable chemical changes. The main objectives of this study were to increase their utilization in poultry and to see the effect of different drying systems on nutritional quality of these bran after fermentation. Therefore, fermentation of bran with rumen liquor (diluted) was conducted for 48h with maintaining appropriate environment. Bran, buffer and rumen liquor were mixed in a ratio of 1:1.5:1, respectively. After brans were dried in a different drying system (oven dry, solar dry, sun dry). Unfermented and fermented bran were analyzed to measure proximate components and other nutrients. The mean values were compared using one-way analysis of variance following Turkey's multiple comparison tests ($P<0.05$). Considering rumen liquor and hour as independent variable, two-way ANOVA was performed. In case of RB, CP was mainly increased 48h fermentation with 100% diluted rumen liquor from $19.5^{a}\pm0.58\%$ from fresh RB $18.9^{b}\pm0.01\%$. In case of WB, CP was $19.5^{a}\pm0.58\%$ from fresh WB $18.9^{b}\pm0.01\%$. CF% decreased after fermentation. CF% of RB changed from $17.5^{b}\pm0.01\%$ to $15.4^{c}\pm0.62\%$. In case of WB, CF% changed from $6.68^{b}\pm0.01\%$ to $5.22^{c}\pm0.54\%$. NDF, ADF and Hemicellulose were also decreased with increasing fermentation time. Amount of EE and NFE were increased after fermentation. Regarding the CP% of RB and WB, there was not a significant difference among drying methods. However, other components, fiber and amino acids, there is a significant difference among different drying systems. Sun drying might be a more effective method if economic feasibility is taken into consideration among other drying systems in case of nutritional composition.

Effect of Replacing Soybean Meal with Organic Acid Treated Shrimp Waste Meal on Production Performance and Egg Quality of Laying Hens

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Abstract
This project aimed to replace soybean meal (SBM) with formic acid treated shrimp waste meal (FTSM) in laying hens diet considering performance and egg quality. Shrimp waste meal (SWM) was treated with 5.0% formic acid resulting in increased CP content (17.98%) and decreased chitin content (4.8%). A total of 90 Lohman Brown, 32 weeks aged laying hens were randomly distributed in 5 dietary treatments for 5 weeks. Diets were CON: basal diet with soybean meal; and others namely, FTSM 1: basal diet with 25.0% FTSM; FTSM 2: basal diet with 50% FTSM; FTSM 3: basal diet with 75% FTSM; FTSM 4: basal diet with 100% FTSM treated by formic acid. Highest hen day egg production (HDEP) was observed in hens given control diet (91%), and lowest ($p<0.05$) in 100% TSM (86%). Similar trend was observed in the case of egg weight. FCR in birds given 25% FTSM and 50% FTSM diet was comparable with CON diet fed hens. The highest value for eggshell weight was recorded in 100% FTSM added diets (7.43 g), however, both 50% and 75% FTSM diets fed hens showed similar pattern of response in terms of eggshell weight. The effect of FTSM in diet was dramatic in case of egg yolk color. According to the Rochy yolk color fan data, the highest value was found in 100% FTSM, followed by 75%, 50% and 25% FTSM. The lowest value was recorded in CON diet given to hens. It may be concluded that replacement of soybean meal up to 25% by formic acid treated shrimp meal may not have any detrimental effect on egg production. Therefore, it may be possible to replace at least 25% of SBM with formic acid treated SM without any negative effect on overall performance of laying hens.

The Role of Networking for Generating Dairy Database in South-East Part of Bangladesh: Application of Regional Modelling Approach

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Abstract
Using regional modeling is an excellent strategy to evaluate regional dairy development potential because it links regional milk production results to national milk production. The modeling of regional dairy farming system would entail require substantial input data sets which are scare not only at regional level but also at national level. To address these challenges, the dairy networking approach is a strong tool which has been beneficial for generating the data, knowledge and bring the required output with limited resources and time. IDRN regional model which is extended to district and sub-district levelthrough several rigorous processes such as the development of farm questionnaire (Input Farm Data-IFD), formation of panel, database team and training, data collection, storing and data validation, organization of national workshop for data validation. The project came up with a breakthrough output of establishing IDRN farm networking model with proper calibration of IFCN model at regional level. It also benchmarked and calibrated 25 variables of 1000 dairy farms and 647 variables of TIPICAL farm from the North-western parts of Bangladesh.Contemporary findings are published in the university website and mass media for stakeholder's benefits.Results revealed that the highest proportion of feed ingredients such as wheat bran (47.9%), mustard oil cake (13.5%), rice polish (58.8%), maize (29.6%) and soybean meal (10.9%) were used in dairy feed ration in Cox's Bazar, Bagerhat, Kushtia, Barishal and Bagerhat respectively. The milk yield was highest in Southern region (2595 kg/farm/year) compared with North (1785 kg/farm/year). The cost of milk production in South was 42.72 BDT/kg ECM while for the Northern part it was 40.27 BDT/kg. The milk price was highest in Cox's Bazar (120 BDT/kg) while the lowest in Bogura (38 BDT/kg). Regarding the model selection and application, regional model provides more insights to make strategic decision, however, it requires in depth data. These findings are dynamic that means update periodically, sustainable and ready to use for future research. It will certainly help to the holistic dairy development of Bangladesh.

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Integrated Dairy Research Network (IDRN) - Way Forward for Sustainable Solutions for Generation and Dissemination of Data and Knowledge for Supporting the Dairy Stakeholders in Bangladesh

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Abstract
The objective of this study was to apply the new and innovative approach of Integrated Dairy Research Network (IDRN) for generation of dairy database using model with specific emphasis to milk production and feeding system. The holistic approach was applied where the different levels of stakeholders were involved in the data generation and validation process for entire project. However, with this report, a part of the project findings that was focused on Sylhet Division has been reported. A three level of questionnaire (L1, L2 and L3) with standard IDRN approach which is improved than traditional data collection tool was applied. A total of 120 dairy farmers were interviewed along with three Key informant Interviews (KII)- Key personnel from Sylhet Dairy Farms, Divisional Director of Sylhet and District Livestock Officer of Moulavi Bazar. The results revealed that the proportion of Business farm in Sylhet is higher (82%) which not unique for the national level as there is only 5-7% business farm in all over Bangladesh. The average milk production per cow per day (expressed in Natural content, ECM andSCM) is used to understand the milk production potential in Sylhet division. Unlike other districts, thedairy cows in Household Farm produces higher milk (17.5 lit/day/cow) than Family (10.8 lit/day/cow)and Business farm (13.2 lit/day/cow) in Natural content (No fat and protein Standardization). The average farmgate milk price is 78 BDT/kg and that for consumer is 94 BDT/kg. Themilk price according to farm types were found to be for farmgate were 76, 79, 78 BDT/kg for HH; FFand BF, respectively. The consumer milk price was 90, 93, and 98 BDT/kg for HH, FF and BF, respectively. As per the IDRN feed type, there are 12 types of feed for dairy cows. As per the IDRN feed type, there are 12 types of feeds for dairy cows among which it was found that family and business farms use 5 different types of feed while the household farms use 4 types of feeds. Concentrate feed intensity was found that for household farm, 340 g concentrate was used to produce a 1 kg of milk while for family farm it was 700 g and for business farm it was 770 g. The international standards set by International Farm Comparison Network (IFCN) Germany was 300 g concentrate per kg milk production. In this sense, our family and business farms our using almost double than requirements which is a scope for improving the feeding management. As regards to the concentrate feed costs, Business farm spent 36 BDT/kg milk production while for family farm it was 29 BDT/kg milk production and household farm (15 BDT/kg milk production. As regards to the network suitability, this network has provided the legal framework for bringing various stakeholders (DLS, International Stakeholders, Farmers, Researchers) to participate in the data and knowledge generation. In addition, the IDRN is linked with IFCN which has provided the strong methodological support toward development of our local methodology. It is expected that at the end of study, the full utilization of networking can be visualized.

Measuring On-farm Consumptive Blue Water Use for Typical Milk Production in Bangladesh

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Abstract
Water is important in lactating cow diets as milk contains 87 percent water, and its consumption is directly correlated with milk production and feed intake. Water is the most important nutrient for dairy cattle. Water intake is affected by different factors such as environmental temperature, ration dry matter content and milk production. The blue water is the indicator of consumption of freshwater that has been sourced from surface or groundwater resources and is either evaporated, incorporated into a product or taken volume of water required for the production

of a given final product. The increasing blue water use is a risk for the environment. Hence, the objective of this study is to estimate the on-farm consumptive blue water use for dairy cows and drivers of water use to know how to efficient in blue water use in typical dairy farms in selected region of Bangladesh. The IFCN water footprint model is applied for estimating the blue consumptive water for a kg milk production. The average blue water used for producing kg Milk ECM is 134 liters for BD-2 while that for BD-14 is 139 liter, implies that small farms require 4% less water. If we consider blue water for feed production, the smaller farms become more efficient as it requires only 83 liters through roughage-based feed to produce kg ECM while that for the large farm is 110 liters, implies that small farm requires 24.5% less water than large farm. As regards the drinking water in the form of blue, small farms require (35.7 liters) almost double (81.2%) than large farms (19.7 liters). The servicing water for small farms is 15.2 liter and 9.7 liter for the large farm. The large might have scope to become efficient in using water fodder production. The ration mainly consists of the rice straw, and it is still impacting the dairy farming system and changing rice straw from the rice based to concentrate based could be a way forward, but economics of fodder production could play significant role.

Feeding the Crossbred Cows with Maize and Jumbo Fodder While Supplied with Formulated Energy Concentrate and Protein Concentrate Mixture: Impacts on Nutritional Status, Productivity and Cost of Milk Production

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Abstract

The aim of this work is to develop a cost effective ration for dairy cow. Twenty Holstein-Friesian cross (HFX) cows for maize fodder group and 16 HFX cows for jumbo fodder group were selected. All the animals were similar in parity, milk production and days in milk. In each fodder, 4 types of protein ration and 4 types of energy ration were supplied. Data obtained were analyzed in RCBD. Fodder type had a substantial effect on fat, SNF, and somatic cell count in milk while in energy ration. Energy ration has significant effect on SNF. On the other hand, both fodder affected fat, SNF, SSC while the protein ration was supplied. Protein ration having the greatest effect on SNF and density of the milk. All the blood parameters were found within the normal dairy range in all feeding regimen. Ration with maize fodder 65.36% and 34.64% energy concentrate mixture (MOC 10.45%, WB 10.56%, maize bran 6.02%, Rice polish 5.22%, molasses 0.88%, DCP 0.76%, RS 0.4%, CS 0.35%), and maize fodder 65.43%; and 34.57% protein concentrate mixture (soybean meal 0.71%, MOC 7.43%, lentil bran 3.99%, wheat bran 10.58%, maize bran 4.25%, rice polish 5.23%, molasses 0.89%, DCP 0.74%, RS 0.4%, CS 0.35%) showed the best results with a profit of BDT 108.6tk and 131.2, respectively. In absence of maize fodder, ration with jumbo 67.32%, MOC 8.92%, WB 9.98%, Rice polish 11.52%, molasses 0.84%, DCP 0.71%, RS 0.38%, CS 0.33% (energy ration) and jumbo 68.45%, MOC 8.02%, lentil bran 3.65%, WB 9.67%, maize bran 3.24%, Rice polish 4.78%, molasses 0.81%, DCP 0.71%, RS 0.35%, CS 0.32% (protein ration) with a profit of BDT 148.9tk and 199.5tk, respectively can be used.

Impact of Peripartum Soybean Meal Supplementation on Lactation Performance of Crossbred Dairy Cow

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Abstract

Twelve Holstein-Friesian crossbred 21 days pre-partum cow were selected for an on farm 60-day long experiment in a completely randomized design to characterize the impact of soybean meal supplementation in concentrate mixture during pre and post-partum period on growth, nutritional status, welfare, milk yield and quality. Selected cows were equally divided into three groups and received concentrate mixture containing 12% CP and ME 9.5 MJ/Kg DM in pre-partum diet and 15% CP and ME 10.5 MJ/Kg DM in post-partum diet, as control group (without soybean meal

supplementation), Pre-partum supplemented group (supplemented with 1 kg soybean meal only in pre-partum period) and Post-partum supplemented group (supplemented with 1 kg soybean meal only in post-partum period). Green German grass after chopping was provided as basal diet and fresh drinking water was supplied adlibitum basis. Result revealed that average body weight (325 – 350 kg/cow), body condition scores (3.25 – 3.42) of the cow found similar among the groups ($p>0.05$). Cow's nutritional status (Serum glucose, triglycerides, albumin, e-creatinine, urea, phosphorus and calcium) were differed non-significantly ($p>0.05$) among the experimental groups except serum total protein which was 0.9-1.2g/dL higher in supplemented group than that of the control group ($p=0.000$). However, with regards to milk production the control cows produce significantly less milk than that of the cows in post-partum supplemented group (2.5 kg milk/cow/day less) and pre-partum supplemented group (2.1 kg milk/cow/day less), respectively. But among the supplemented groups the milk production was found similar ($p>0.05$). All the milk quality attributes were found similar in all three types of diet ($p>0.05$), except somatic cell count. The somatic cell count was significantly less in pre-partum supplemented cows followed by post-partum supplemented group and the highest was found in control group ($p=0.035$). Finally, soybean meal supplementation was found better in terms of daily milk yield and maintaining udder health.

Effect of Protein Supplementation on the Lactation Performance of Crossbred Dairy Peripartum Cow

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Abstract

Ten Holstein-Friesian crossbred 60 days pre-partum cow were selected for an on farm 100-day long experiment in a completely randomized design to characterize the effect of high protein supplementation in diet during pre and post-partum period on growth, nutritional status, welfare, milk yield and quality. Selected cows were equally divided into two groups. Control group received a diet containing 11% CP and ME 10 MJ/Kg DM in pre-partum period and 13% CP and ME 10.5 MJ/Kg DM in post-partum period, and supplemented group received a diet containing 13% CP and ME 10 MJ/Kg DM in pre-partum period and 15% CP and ME 10.5 MJ/Kg DM in post-partum period. Fresh drinking water was supplied adlibitum basis. Result revealed that average body weight (335 – 360 kg/cow), body condition scores (3.30 – 3.48) of the cow found similar among the groups ($p>0.05$). Cow's nutritional status (Serum glucose, triglycerides, albumin, e-creatinine, urea, phosphorus and calcium) were differed non-significantly ($p>0.05$) among the experimental groups except serum total protein which was 0.9g/dL higher in supplemented group than that of the control group ($p=0.000$). However, with regards to milk production the control cows produce significantly less milk than that of the cows in supplemented group (2.1 kg milk/cow/day less) respectively. All the milk quality attributes were found similar in all two types of diet ($p>0.05$), except somatic cell count. The somatic cell count was significantly less in supplemented cows than that of the control group ($p=0.035$). Finally, high protein supplementation in pre and post-partum diet was found better in terms of daily milk yield and maintaining udder health.

Comparative Analyses on Growth, Laying Performance and Egg Quality of Available Layer Strains in Bangladesh

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Abstract

Various factors have been reported that affect the growth performance of layers, such as genetics, nutrition, environment, and disease. Attaining appropriate growth is essential to ensure profit. To evaluate the production performances and egg quality of four commercial layer strains in Bangladesh, a total of 128 laying pullets including NOVOgen brown, ISA brown, Hy-line brown, and Bovans brown were randomly allocated at 4 different treated groups (one individual strain treated as separate treatment) having 4 replications and 8 birds in each replication. A

commercial layer diet purchased from Kazi Farms Group was fed to the experimental birds and identical management was provided to the birds irrespective of their strains. Data on feed intake, egg production, and body weight were recorded and thereafter egg mass and feed efficiency were calculated. Eggs were collected from the respective treatments and subjected to external and internal egg quality analysis. The results revealed that there were no significant differences among the growth performances (weekly body weight, feed intake, uniformity, and survivability) of four commonly available layer strains, and all the strains followed the standard very closely. The results revealed that Hy-Line brown had significantly ($p<0.001$) lower feed intake compared to other strains. On the other hand, NOVOgen Brown had a significantly ($p<0.05$) higher shell thickness among others. Other laying performances such as hen-day egg production, average egg weight, egg mass, and egg quality parameters such as shape index, Haugh unit, albumen index, and yolk color score did not affect significantly ($p<0.05$). Taken together, it may be concluded that there were almost no statistical differences with the growth, laying performance, and egg quality among the strains compared in this study. Also, the layer strains available in Bangladesh are highly competitive and suitable for local climatic conditions.

Supplementation of Lemon Juice to Combat Heat Stress in Layers

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Abstract

The production of good quality eggs with maintaining the health of laying hens is one of the most critical goals of the industry. Supplementation of the diet or drinking water with special nutrients has been proposed as a means to improve laying performance and to reduce the effects of heat on the layer hens. There is scant information about the effects of natural compounds on the performance enhancer and heat-stressed hens. In this regard, the present study aimed to evaluate the effects of fresh lemon juice on the performance, egg quality, and serum biochemical parameters of laying pullets. A total of 96 Hy-line Brown layers aged 29 weeks were randomly assigned to 4 groups and lemon juice (LJ) was daily added to drinking water (0%, 0.5%, 1%, and 1.5%) with a duration of six hours (10 am to 4 pm). The necessary data related to laying performance and one egg from each replicate was collected and maintained every two weeks intervals to analyze egg quality parameters. Blood sample from reach replication was collected and analyzed for serum biochemical parameters. The LJ did not affect on the laying performance and egg quality parameters, except, the yolk index increased significantly ($p<0.05$) in the 1.5% LJ group. Among the blood biochemical parameters total cholesterol, LDL, and glucose levels in the blood reduced significantly ($p<0.001$) with the supplementation of LJ, and the lowest values were observed in the 1.5% LJ-supplemented group. The decreased level of blood biochemicals such as glucose, H/L ratio, ALT, and AST enzymes in the LJ supplemented groups indicates that LJ has a positive effect to reduce heat stress in layers. In conclusion, the water supplementation of LJ showed positive effects on production without adverse effects on egg quality parameters and reduced the heat stress in laying pullets. Thus, LJ may be considered as the natural supplement to combat heat stress in laying hens under hot and humid climatic conditions.

Development of Dietary Fiber Enriched Chicken Nugget Using Wheat Bran

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Abstract

An experiment was conducted to find out the effect of different levels of wheat bran on the sensory, oxidative stability, physicochemical properties in different storage period of broiler meat nugget. For this purpose, nuggets were prepared in 3 different groups. They were T_1 (chicken nugget incorporated with 0% wheat bran), T_2 (chicken nugget incorporated with 5% wheat bran), T_3 (chicken nugget incorporated with 10% wheat bran). All parameters were analyzed at 0th, 14th and 28th days. The sensory evaluation was evaluated at day one. The proximate composition of different nuggets was analyzed and highly significant differences were found in CP (%) and CF (%).

Significantly, higher CF (%), Ash (%) were found in T_3, while CP (%) was significantly higher in T_1. No significant differences were found in EE (%) and DM (%) among the treatments. Storage period had highly significant on CP only. CP (%) content is increased with increase of storage period. The surface color (CIE L*, a*, b*) of nugget samples were measured. Significantly, the highest lightness value was found in T_1 and lowest value was found in T_3. Storage period had an effect on lightness value also. Increasing the storage value lightness decreased. Treatment had no effect on pH, but storage period had effect on pH. Significantly, lower pH was found in 14th days of storage period. During biochemical analysis, it was found that treatment had no effect on free fatty acid value (FFA), peroxide value (POV) and Thiobarbituric acid reactive substances (TBARS). However, storage period had effect on FFA, POV and TBARS value. Increasing the storage period FFA, POV and TBARS values increased. During sensory analysis, all parameters including overall acceptability did not differ among the treatments concluded that wheat bran up to 10% can be used in nugget preparation with no change in consumer acceptance.

Establishment of Model Mini Poultry Processing Plant for the Production of Hygienic and Safe Broiler Meat for BAU Community

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Abstract

Food safety has become extremely important and ensuring product safety is an international public health concern as well as in Bangladesh. The project activities were done in two steps. Firstly, to observe poultry slaughtering area conditions in the local market of Mymensingh and to assess the microbial quality of poultry meat produced from the local market and processing unit. Secondly to establish a mini processing plant at BAU poultry farm. A 150 sft open-sided processing plant was established at BAU poultry farm. Data were collected from twenty-four poultry shops in twelve local markets. Results indicate that most of the poultry shops have a lack of floor space, improper drainage systems, inadequate lighting facilities, dirty bleeding areas, unhygienic meat cut-up areas, and unplanned waste disposal systems. Twenty-four meat samples (thigh and breast) were collected from twelve poultry markets and two from a processing unit for microbial analysis. The total viable count in all the samples collected from the local market varied between log 4.52 cfu/g to log 6.16 cfu/g and the total viable count of meat from the processing unit was log 4.50 cfu/g. The total salmonella counts of the meat sample from the local market varied between log 3.71 cfu/g and log 5.59 cfu/g whereas no salmonella was found in the meat sample of the processing unit. Total coliform count in the meat sample of local markets varied between log 4.01 cfu/g to log 5.94 cfu/g whereas no coliform was found from the meat sample of the processing unit. Meat samples collected from the local poultry market had higher bacterial count which indicates the unhygienic condition of the poultry market whereas meat samples from the processing unit had a lower total viable count and no salmonella and *E. coli* were found there which indicates proper hygienic practices were followed in processing unit. So, it can be said that poultry meat produced from processing units is safe for human consumption in terms of bacterial count and it is suggested to highlight this for increasing public awareness.

Effect of Day Old Chick Weight on Growth Performances and Egg Production Traits in Japanese Quail

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Abstract

The weight of the birds and their development during the growth phase are factors that influence the weight of the first eggs. It is also important to observe the adequate weight of the quails at the end of the rearing period. This study was conducted to investigate the effect of Effect of day old chick weight on growth performances and egg production traits in Japanese Quail. Two trials were done during the growing period (0-6 weeks) and the laying period of Japanese quail. In trial 1, chicks were divided into four groups each of 100 on day 7, replicated to four sub-groups each of 25 birds. Treatment-1 was below 20g, Treatment-2 was 20-22g, Treatment-3 was 23-24g and

Treatment-4 was over 24g. In trial 2, chicks were divided into five groups each of 35 at the onset of laying, replicated to four sub-groups each of 7 quails. Treatment-1 was below 130g, Treatment-2 was 130-140g, Treatment-3 was 140-150g, Treatment-4 was 150-160g and Treatment-5 was mixed body weight. Results from trial 1 indicated that body weight and body weight gain were higher in the higher weight group compared with other treatment groups. Fed intake and FCR were also improved in the over 24g group than others. Results from trial 2 indicated that egg production was highest in the 150-160g group whereas, below 130g, 130-140g and 140-150g show the same egg production percentage. However, the mixed body weight group indicated lower egg production than others. Egg weight was almost the same in all the treatment groups. Based on the results of this study, it may be concluded that quail separation on the basis of body weight at 7 days and onset of production may be effective, and higher weight gives higher body weight and higher egg production.

Impacts of Stocking Density on Growth Performance and Welfare status of Broilers

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Abstract

This experiment was conducted to compare the effect of stocking density on growth performance and welfare of broilers. A total of 400 day-old Cobb 500 broiler chicks were randomly assigned to 4 different treatment groups for five weeks. The treatment groups were; low-density group (10 birds/sq. m), medium-density group (12 birds/sq. m), high-density group (15 birds/sq. m) and very high-density group (18 birds/sq. m). Each treatment consisted of 4 replicates and each having 25 chicks. Throughout the experimental period body weight, feed intake, feed conversion ratio were recorded as growth performance and plumage score, foot pad score, hock burn, breast blister and litter quality were taken for welfare issues. At the end of feeding trial, dressing yield parameters of broilers from each replication were taken. Grading of live and dressed broiler's was also performed after rearing. Results revealed that there were significant effects of stocking density on growth Performance, plumage score, hock burn, foot pad score and litter quality. An improved FCR was noticed in the low and medium-density group compired to high and very high-density group. Higher stocking density significantly decreased the feather quality of back, wing, tail and litter quality, while increased the incidence of foot pad dermatitis and hock burn compared to the low and medium density group. Both live and dressed grading exhibited better in low-density birds compared to birds rearing at high-density. There were no significant differences in meat yield (breast meat, thigh meat, drumstick meat and wing meat), bone development (thigh bone, drumstick bone and wing bone) and carcass weight (head, neck, leg, liver, heart) among different treatment groups. Based on the results of this study suggest that the bird's rear in lower stocking density could be suitable for better grade, performance and welfare status of broilers.

Comparison of Different Antibiotic Alternative Supplements in Drinking Water on Growth Performance, Carcass Characteristics and Blood Biochemical in Broilers

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Abstract

This experiment was conducted to compare the effect of probiotic, synbiotic and citric acid as alternatives to antibiotic supplements on growth performance in broilers. A total of 400 day-old Cobb 500 broiler chicks were randomly assigned to 4 different treatment groups for five weeks. Each treatment consisted of four replicates and each having 25 chicks. The treatment groups were; control group (no additives), citric acid group (2.5g/liter water), synbiotic group (0.2g/liter water) and probiotic group (0.5g/liter water). Throughout the experimental period body weight, body weight gain, feed intake and feed conversion ratio were recorded as growth performance. Carcass characteristics and blood biochemical profiles were also taken after the end of the feeding trial. The supplementation of additives in drinking water had a significant ($P<0.05$) effect on growth performances. Results showed that

probiotic-treated broilers had significantly (P<0.05) higher body weight and body weight gain at the end of the experiment compared to control group. Significantly better FCR (P<0.05) was also noticed in probiotic group (1.62) compared to the control group (1.71), citric acid group (1.66) and synbiotic group (1.70). There were no significant differences in meat yield, bone development and carcass weight among different treatment groups except gizzard and abdominal fat weight. Total cholesterol and LDL found significant (P<0.05) differences among the treated groups whereas TG and HDL exhibited no significant difference. With regards to profit, probiotic groups showed higher profitability compared to control group. Based on the results of this study suggest that the addition of citric acid, synbiotic, and probiotic to drinking water could be a potential additive in broiler and probiotic could be considered a better antibiotic alternative for broiler production.

Production of Omega-3, Antioxidants Enriched and Low Cholesterol Eggs Through Available Resources

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Abstract

Nutritionally enriched eggs are those in which the content has been enriched or modified or designed according to the consumer's choice or present market demand from the standard egg. Improving consumers' health and nutritional status by designing nutritional profile of poultry egg through dietary approaches is relatively simple and economic. The purpose of this research is to develop omega-3, antioxidant, conjugated linoleic acid, micro-minerals enriched and low cholesterol eggs by using available resources. Also, to investigate the cost benefit analysis of producing nutritionally enriched egg in Bangladesh. The activities of 1st year research were literature collection, purchase committee formation, MR labor sanction, MS student recruit committee formation, bird collection from reputed hatchery, house preparation, cage installation and preparation, feed formulation and additives purchase completed. After preparation of house and collection of bird, trial-1 that is production of low cholesterol enriched eggs by different medicinal plants is running. Therefore, the result of the proposed research work, if found cost effective, would necessary to establish it as potential and safe food for human consumption also, to create awareness of selected poultry farmers for production of nutritionally enriched egg by proper training.

Comparison of Different Medicinal Plants for the Production of Antibiotic Free Low Cholesterol Eggs

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Abstract

An experiment was carried out with laying hens to investigate the effects of feeding garlic (*Allium sativum*), moringa (*Moringa oleifera)* and green tea *(Camellia sinensis)* leaf meal at different dietary concentrations on cholesterol metabolism and productivity of laying chickens. Total 112 Hyline brown layer hens at 41 weeks of age were allocated into seven dietary treatments with four replications. The experimental diets were Control group (Basal diet with no supplementation); Garlic-0.5% (Basal diet with 0.5% Garlic powder supplemented group); Garlic-1% (Basal diet with 1% Garlic powder supplemented group); Moringa-0.5% (Basal diet with 0.5% moringa leaf powder supplemented group); Moringa-1% (Basal diet with 1% moringa leaf powder supplemented group); Green tea-0.5% (Basal diet with 0.5% green tea supplemented group) and Green tea-1% (Basal diet with 1% green tea supplemented group). All birds were housed in cages had *ad libitum* access to water and were fed 115g feed per bird per day. Egg production, internal egg quality and yolk cholesterol were tested among the treatment groups. Inclusion of garlic, moringa and green tea in diets of laying hens showed non-significant differences (P>0.05) on egg production during the experimental period. A slight ups and down in egg production was seen throughout the period in all dietary groups. However, Moringa (1%) group showed numerically better production than all other groups in this experiment. Egg weight showed no significant (P>0.05) differences during period. Supplementary groups showed numerically higher egg weight than control group at the end of the study. The performance of Moringa (0.5%) group was better than any other groups in terms of egg weight. Internal quality of egg was

replicated in two times during the trial period. Data presented that there were no significant differences (P>0.05) among the dietary groups on shape index, shell thickness, albumen index, yolk index and yolk color. However, Green tea (0.5%) and Garlic (0.5%) group showed slightly progressive values on egg yolk index (0.48 at 5thweek & 0.50 at 9th week respectively) compare to other dietary groups. Shape index was better (78.41) in Garlic (0.5%) group at 5thweek and Moringa (1%) group (81.01) at 9th week compare to other dietary groups. It is concluded from the study that supplemented groups had no negative effect on egg production, egg weight and egg quality characteristics. It is suggested that Garlic, Moringa and Green tea can be used in suggested doses in layer diet for the production of safe eggs.

Evaluation of the Quality of Commercial Feeds from Selected Leading Companies Considering the Growth Performance, Carcass Yield and Meat Quality of Broiler Chickens

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Abstract
The present study was conducted to evaluate the nutrient efficacy of different available commercial feeds from randomly selected renowned companies. Eleven commercial company feeds along with self-formulated feed (SFF) were considered for this experiment. A total of 480 Indian River Meat male broiler DOCs were reared at an open-sided gable-type house. The birds were divided into 12 treatment groups namely, T_o=Self formulated feed, T_1=commercial feed 1 (CF1), T_2=CF2, T_3= CF3, T_4=CF4, T_5=CF5, T_6=CF6, T_7=CF7, T_8= CF8, T_9= CF9, T_{10}= CF10, and T_{11}= CF11 having 4 replications and 10 DOCs per replication. Data for nutritional quality assessment, growth performances, survivability, carcass yield and meat quality parameters were considered. Results showed little variation in ME:CP ratio of CF samples (133-145) during starter phase, however, huge variations (133-160) were found in the CF samples at grower phase. Significant changes ($p<0.05$) were observed in growth performance where the birds of T_1 treatment group showed the highest body weight (2381.51g), body weight gain (2339.79g) and feed intake (3645.38g) compared to other treatment groups and the lowest in T_o treatment group, resulting in higher ($p<0.05$) FCR (1.92), whereas, the T_7 showed significantly ($p<0.05$) the lowest (1.53). The drip loss of breast meat was remained unaffected ($p>0.05$) by treatments but significant impact ($p<0.01$) was observed in the cooking loss and color of breast meat among the different treatment groups. Birds in T_1 treatment group displayed higher cooking loss (34.27) but lowest was in T_o group. T_2 treatment group showed higher ($p<0.05$) lightness but lower yellowness (2.57) of breast meat color among all the other groups. The lightness of breast meat was significantly ($p<0.05$) lower (40.10) but redness was higher (16.12) in T_o group compared to other treatment groups. Based on the above findings, it can be concluded that huge heterogenicity is present in nutrient availability of different commercial feeds, which may be due to variations in the use of some unknown feed additives or higher difference in nutrient composition at grower phase that ultimately have an influence on final growth performance and meat quality of broiler chickens.

Exploring the Potentiality of Nata-De-Coco Scraping as Feed Additive for Longer Life Hen

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Abstract
A series of experiment was conducted on 100+ week older laying hens to investigate the effects of feeding Nata-De-Coco Scrapings (Nata-Scrap) alone or in combined with the Ca and Vitamin-D on body weight maintenance, egg production, egg qualities, gut microbial profiles, and egg production related anatomical and physiological fitness of the hens towards longer productive life. In the first experiment, the doses of 0, 10 and 20 ml Nata-Scrap /litre drinking water were supplied to the birds. Results indicated equal survivability rate in the hens irrespective of the doses of the Nata-Scrap used. Significantly ($p<0.05$) higher egg production was observed in the Nata-Scrap groups.

Majority of the egg quality characteristics were found to be affected significantly by Nata-Scrap feeding including the eggshell colour. The serum Ca ($p>0.05$) and P ($p<0.05$) levels were higher in all the Nata-Scrap fed hens. The loads of the pathogenic bacteria in gut content were found to be lowered at Nata-Scrap fed hens along with desirable anatomical and histological changes in the vital organs and oviduct. In 2nd and 3rd experiments, the effects feeding Nata-Scrap were investigated combining it with eggshell derived Ca (EDCal) and synthetic vitamin-D3 respectively. Results showed that the EDCal addition increased egg weight but decreased egg production rate, whereas Vitamin-D3 addition decreased egg production rate keeping the egg weight unchanged. The Nata-Scrap feeding had incurred additional production cost Tk 0.10 - 0.20 per hen per day, which increased to Tk 0.20 - 0.30 per hen per day when the EDCal and Vitamin D3 were added. It was concluded that the feeding of Nata-Scrap alone at a rate of 10 to 20 ml/litre in drinking water can prolong egg production life in 100+ weeks older hens, at least by 10 weeks, along with an enhancement in the egg production rate and egg quality characteristics at reasonable additional cost.

Grade Variation Effects of Corn (Zea mays) on Broiler Performance and It's Cost-effective Mitigation

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Abstract

The present study was carried out to evaluate the effects of grade variation of maize/corn with fortification of oil, critical amino acid and some feed additives on the growth performance and cost effectiveness of broilers production. A total of 252 broiler chickens (Cobb 500) were reared from day 1 to d 35 and assigned to 3 dietary treatments (4 replicates/treatment and 21 birds/replicate). The dietary treatments were, T0= Standard broiler feed contained A-grade maize; T1= Standard broiler feed contained B-grade maize (where the maize-grade created deficiency of protein and energy is fulfilled through critical amino acids and soybean oil respectively and also fortified with multi-enzyme and toxin binder) and T2= Standard broiler feed contained B-grade maize (where the maize-grade created deficiency of protein was not fulfilled but energy deficiency was fulfilled by oil and no fortification was done with multi-enzyme and toxin binder). The broiler was provided with starter (1-14 d) and grower (15-35 d) feeds. Starter diet was commercial industrial feed and the grower diet was pelleted with locally available feed ingredients. Total 9 broilers (one broiler per replication) were slaughtered at day 35 and data were collected and recorded for further investigation and calculations to observe the effect on body growth and meat yield characteristics. The survivability of the broiler was 93.7% from day 15 to 35 days old in all groups. The broilers those received T2 diet gained relatively higher weight, although the body weight gain of broilers at different dietary groups did not differ significantly ($P>0.05$). However, the trend of weight gain over the period in T2 was more prominent than the others. The total feed intake of T0, T1, T2 during 0-35 days were 3231, 3222.1 and 3 222.1g feed/bird, respectively. The feed conversion ratio was 1.48, 1.49 and 1.45 in T0, T1, T2 respectively. However, the differences in feed consumption of broilers among the dietary treatments' groups were not significant ($P>0.05$). In case of meat yield characteristic, no significant difference was observed in the dietary groups. Small intestine length, caeca length, breast meat%, leg meat %, liver%, heart%, blood% and spleen weight% were not affected ($P> 0.05$) by the diets. It was concluded that the T2 diet attributed relatively higher favourable effects on the FCR, feed intake, and body weight gain. For higher profitability in broiler production, grade-B maize can be used after fortifying with energy only.

Optimization of the Extracellular Expression of Short Peptides through a Yeast-based Peptide Expression System

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Abstract
Amino acids are protein's building blocks and they play vital physiological roles in the body. After absorption, amino acids are assembled and metabolized to form proteins that are used to build different body tissues. They are functional and structural units of protein, nutritionally classified into two groups: non-essential (synthesized in the body) and essential amino acids (cannot be synthesized rapidly enough to meet the metabolic requirement). Like other mono-gastric animals, poultry birds cannot synthesize all the amino acids within their body. Previous studies indicated that providing a high protein and energy-rich diet to chickens in their growth and egg-laying phase showed positive effects on body weight, egg mass and yolk weight. Therefore, several essential amino acids such as lysine, methionine, threonine, and tryptophan must be supplied to the poultry diet for optimum growth and production. Bangladesh's poultry industry is exclusively dependent on imported synthetic amino acids and every year we are spending about US$75 million on importing feed-grade amino acids mainly for commercial poultry. We previously developed and optimized *in vitro* single-cell protein production techniques for poultry. Later on, three plasmid constructs (*pbgl_01, pbgl_02,* and *pbgl_05*) rich in lysine, methionine, and tryptophan triplet codon were constructed using a designed array of nucleotides. The findings of our previous study indicated that these plasmid constructs are able to express lysine, methionine, and tryptophan rich synthetic short-chain linear peptides. Thus, the purpose of this study was to optimize the extracellular expression of short peptides through a yeast-based peptide expression system. In this study, three synthetic DNA constructs were sub-cloned in to plasmid vectors of which one constructs were able to extracellular expression methionine and lysine rich synthetic short peptides with molecular weight of 3.525 kDa (*Confirmed by SDS PAGE*). Structural and molecular analysis suggests that the synthetic DNA constructs has potential for expression in yeast expression system without toxic effects.

Assessment of the Status of Genotypes and the Technical Interventions Required by the Color Chicken Producers

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Abstract
White-feathered broilers dominate poultry meat production in Bangladesh owing to their rapid growth and high feed efficiency. On the contrary, consumers' preference for slow-growing color chicken is rapidly increasing due to their better taste, suitability for local cuisine, and food safety issues. However, the status of available slow-growing color chicken and their efficiency is poorly evaluated. Therefore, a study was carried out to assess the status of genotypes and the technical interventions required by the color chicken producers in some selected region of Bangladesh. The primary data was collected by face to face interview and focus group discussion, whereas the secondary data were collected from published reports, academic journals and scholarly literature. Collected data were analyzed and summarized according to variable type/s. The color chickens were initially produced and popularized in Bangladesh by using Sonali chickens, which are generally slow-growing with poor feed conversion but bear alikeness to indigenous chickens. Currently, the breeding for colored chickens in Bangladesh is characterized by crossbreeding among native genotypes, exotic breeds, and highly-selected local and imported lines. In response to the market demand for tough-meated birds, small and medium farmers are rearing Sonali and their derivatives birds but their performance also varies from farm to farm. The lower productivity and increased disease susceptibility of these non-pedigreed parental birds might hindering their efficiency for profitable production. The growth and feed efficiency of existing native, Sonali and other crossbreds are very poor, therefore, the production cost of these chicken is very high. The incidence of mixed infections are more prevalent as compared to single infection. The findings of this study indicated that the lack of pedigreed genotypes and poor technical knowhow for production and management are the major limiting factors for sustainability and efficiency of small-scale color chicken producers in Bangladesh.

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Construction of Infrastructures for the Conservation and Improvement of the Parental Lines of BAU Chickens

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Abstract

We developed two meat type chicken strains, BAU-Bro white and BAU-Bro color in 2014 to reduce the dependency on imported chicken strains and later on a validation and refinement study was conducted in different areas of Bangladesh. The findings of the farmer's farm level study indicated that the developed strains could be reared at farms level profitably and there is a significant demand of BAU-Bro chickens is prevailing. Therefore, the proposed project was undertaken to establish a "BAU Chicken Conservation and Research Centre" at BAU Poultry Farm for the purpose of conservation and improvement of the parental lines of BAU-Bro chickens and upscaling their production. After inception, the project was suffered significantly due to land allocation issues, covid-19 pandemic and other complexities that had arisen at the implementing organization. Recently, the initial tripartite agreement is jointly amended and accepted by Krishi Gobeshona Foundation (KGF) and Bangladesh Agricultural University (BAU). Then the project timeline was rescheduled and the required land for the construction work has been allocated by the university authority. To date, the land development work has been completed and the construction of tunnel ventilated poultry shed and hatchery is ongoing. In addition, the procurement of goods required for the project is restarted. It is expected that the construction works will be completed by June, 2024. As per the revised timeline, the multiplication of parental stocks will be started after completion of shed construction. Genotyping of parental lines has been started from the previously isolated DNA form generation 16 (G16).

CHAPTER IV

Faculty of Agricultural Economics and Rural Sociology

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Traditional Profession, Livelihood and Multiple Deprivations: A Study on the Cleaners Community of Mymensingh Municipality, Bangladesh

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Abstract
The most marginalized minority in Bangladesh is the cleaners community. In addition to being denied access to necessities, they are excluded from larger society. The study aims to find the traditional profession, livelihood situation of cleaners community and to explore multiple deprivations that cleaners communities encounter on a daily basis. Primary data were collected purposively from 60 randomly selected cleaners from the Mymensingh City Corporation. Descriptive Statistics and qualitative methodology were employed to analyze the data. The findings show that all household of the sweeper are being deprived from socioeconomic advantages, comparatively with general community. The major findings of the study showed that about 35% of the respondents belonged to the age group 35-44 years, 65% had primary education only, 92% people have been working as cleaners in Mymensingh city and 99% sample cleaners belongs to Hindu religion. Most of the sweeper's households are burden by excess expenditure over income. Maximum household have loan burden and a very few have savings and only three percent have investment which shows their vulnerability. Using in-depth interviews and analyzing documents, this study shows that the cleaners are being separated from mainstream society which results in numerous deprivations. It contends that cleaners community don't have sufficient access to income, accommodation, social networks, education and labour market creating a life full of hardships for them.

Waste to Energy Generation at Bangladesh Agricultural University Campus: Possible Scenarios to Generate Energy and Organic Fertilizer

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Abstract
This study is examined the status of solid waste generation, potential waste to energy generation and technology selection of waste management at Bangladesh Agricultural University Campus area in Mymensingh. About 63 households including teachers, officers, employees and two male student and one female student halls and a market named K. R. Market were selected for data collection. Data collection was conducted in winter and summer seasons of 2022. The inhabitants including teachers, students, officers, employees of this university generate 5.21 to 5.92 tons of organic waste per day and 0.18 to 0.23 tons of inorganic waste per day in 2022. This study will be able to present the waste to energy conversion technologies such as waste incineration, pyrolysis, gasification and anaerobic digestion to convert the waste into energies. It is found that 2.7 MWh, 1.56 MWh, and 4.6 MWh and 0.78 MWh electricity could be produced by using the incineration, pyrolysis, gasifier and anaerobic digestion process at BAU campus and .023 t CH4/t SW and .828 t CO2/t SW emission will have reduced due to practice of the above four technologies. About 8% biochar from gasifier, 25% ash from pyrolysis, and incineration process will be generated as well as practiced for soil improver in same campus. A pilot based Solid waste anaerobic digested treatment plant can be established at BAU campus for energy production and remaining organic fertilizer would be used for increasing the soil fertility. Waste is being treated as asset, now-a-day to the society; many cities are developing the business model on waste to value, while waste should be treated as valuable product not like a liable to the society. Lack of regulations or standards for waste disposal, lack of proper awareness, improper choice of technology and inadequate financial support are the major constraints for waste management at Bangladesh Agricultural University Campus Area in Mymensingh.

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Changes in Women Economic Empowerment and Its Impact on Household Livelihood: A Socio-economic Study of Harijan Community in Cumilla District

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Abstract
The Harijan caste, which is one of 44 Hindu castes, is the most marginalized in society and have long been socially oppressed, economically disadvantaged, culturally subjugated, and politically impotent in Bangladesh (Chowdhury, Islam and Uddin 2009). This community has long been subjected to severe social and economic discrimination. Among them women from Harijan community earn less than male and have experienced no improvement in their situation despite the efforts of women organizations and consecutive government commitments. In our targeted place, Cumilla district, Harijan women are working in Cumilla Medical College Hospital, Cumilla University, Cumilla City Corporation, Bangladesh Academy for Rural Development (BARD), and different institutions as sweeper. Beside they cultivate vegetables in their yard and rear different livestock specially pig. This research have helped us to find out the changes in women economic empowerment and their contribution to the current household livelihood trend of this community, and also helped to provide some core recommendations to upgrade their socio-economic status. Household data was collected through personal interviews during the month from April to June 2022. The Women Economic Empowerment Index attempts to do so, examining 60 households for which data was available. Log-log regression model has been used to find out the impact of some explanatory variables on sweeper women's income. The explanatory variables are age of the respondent, family size of the household, experiences of sweeping, year of schooling of the respondent, involvement in farming activities and receiving urban facilities. Most of the variables in the model had significant impact on sweeper womens' income. To assess the impact of sweeper women's income on livelihood, DFID recommended livelihood framework has been used. All kinds of livelihood assets have increased after women being empowered economically. Overall human capital, social capital, financial capital, physical capital and natural capital have increased than the last 20 years. Women of Harijan community are at the bottom of social stratification. Patriarchal mind set of society make them more vulnerable. They become victim of many crimes. Situation is changing now a days by breaking the wall of their traditional society. Participation in various income generating activities in urban areas is helping their family economically and to make their voices in the family and society. Vibrant policies should be developed concentrating on their engagement in economic activities in order to increase their socioeconomic empowerment.

Improving Farmers' Income and Livelihood through Green Grass Production in Major Milk Pocket Areas of Bangladesh: A Socioeconomic Study

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Abstract
The study was conducted to assess the impact of cultivating green grass on farmers' income and livelihood in major milk pocket areas of Bangladesh. A total of 180 farmers were interviewed following stratified random sampling technique from Sirajganj, Pabna and Rangpur districts. A combination of descriptive, mathematical and statistical techniques was used to analyze the data. Green grass is one of the major ruminant foods and its nutritive value is very high. Regarding farmers' perception, green grass production emphasized on cost minimization in cattle feeding, potential use of fallow land and sharing of work within household members. Financial profitability of green grass production was measured in terms of gross return, gross margin, net return and benefit cost ratio. It was found that benefit cost ratio (BCR) of green grass production was 1.84 and it was comparatively profitable than the competing crop. Partial budget analysis was used as a planning and decision-making framework to compare the costs and benefits of green grass production and its alternative crop i.e., *Boro* rice production. Estimates of Logit model indicates that age of household head, annual income from grass production, households' training and experience in green grass production were the significant factors influencing farmers' decision to adopt green grass production.

Through green grass production, majority of the farmers' experienced improved states of their socioeconomic status and livelihood capitals in terms of human capital, social capital, financial capital, natural capital and physical capital. SWOT analysis indicated less requirement of labour and other inputs as strength, low price of product as weakness, high demand in domestic market as opportunities, and uncertain flood as threat. The study recommended that high yielding fodder varieties should be considered for seed production, preservation and processing facilities should be improved and necessary training should be provided by government and non-government organizations.

Sugarcane *Goor* Production in Bangladesh: A Study on Farmers' Perception and Financial Profitability

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Abstract
This study was undertaken to assess farmers' perception and to estimate the financial profitability of sugarcane *goor* production in Chapainawabganj and Sirajganj districts of Bangladesh. A total of 90 farmers were interviewed based on stratified random sampling technique using a structured questionnaire to collect primary data. A combination of descriptive, mathematical and statistical techniques was used to analyze the data. The study depicts that most of the sugarcane *goor* producers were small in farm size. They cultivated garlic and onion as the intercrops between the row of two lines of sugarcane. Intercrop practices, soil fertility and sugarcane *goor* price are the main factors influencing farmers' perception of sugarcane *goor* production. Financial profitability analysis shows that sugarcane *goor* production was highly profitable in the study areas. The study identified five significant factors, i.e., cultivating intercrops, sharing work among household members, owner of a crusher machine, income generation and access to training facilities which influence farmers positively to adopt sugarcane *goor* production. The study identified lack of clean seed, low output price and lack of knowledge on grading as the major input, production and marketing related problems, respectively. Based on the findings, the study recommended to develop high-yielding sugarcane variety and to ensure fair selling price as well as proper grading of the product. Moreover, government and non-government organizations should motivate farmers by providing modern crusher machines and clean seeds for producing sugarcane *goor* more profitable.

Impact of COVID-19 on Food Security and Livelihood of Indigenous Garo Community in Bangladesh

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Abstract
The present study was designed to measure food security, livelihood status, vulnerability status and coping strategies of Garo community after COVID-19 circumstances. The study was conducted in several villages of two upazilas namely Madhupur of Tangail district and Haluaghat of Mymensingh district. Primary data were collected from a total of 300 households using a structured questionnaire. Household Food Insecurity Access Scale (HFIAS) was estimated to assess the food security status. Binomial Regression model was used to identify the factors affecting food security status. Livelihood Assessment Index (LAI) was used following the DFID's sustainable livelihood framework (SLF). Socioeconomic vulnerability index (SeVI) was also measured that included demographic, social, economic, and physical characteristics as well as exposure to COVID-19. The study found that 7% households were food secure during COVID-19 whereas 59% were food secure after COVID-19. Overall Livelihood index was found 0.593 after COVID-19 that represented households belonged to moderate livelihood status. The socioeconomic vulnerability index (SeVI) was calculated as an index score. Overall SeVI score was higher (0.416) during COVID-19 than after COVID-19 (0.3). The economic options for households were greatly limited by the consequences of the COVID-19 pandemic. Swapped consumption to less preferred or cheaper foods was found to be the most practiced coping strategy. The study also found that reduction in the number of meals per day, reduction in the size of meals, borrow money from a friend or relative, purchase food on credit, household migration out of the area, sale

of crop and livestock, sale of household assets were also practiced to mitigate food insecurity. It is assumed that the research results will generate significant information to the concerned stakeholders to take necessary steps to overcome the challenges of Garo community related to food security, livelihood status, vulnerability and coping strategies after COVID-19 circumstances.

Adoption of Climate Resilient Crop Varieties in Selected Environmentally Vulnerable Areas of Bangladesh and Its Impact on Farm Productivity

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Abstract
In Bangladesh, there is a lack of studies that have comprehensively investigated the varietal adoption, considering all the climatic stresses observed in the country. It is also a question whether the adoption behaviour has any impact on farm profitability and productivity. Therefore, this research aims at answering these questions in a comprehensive manner, covering climate resilient crop varieties in six different environmentally vulnerable areas that covered four geographically hotspot areas of Bangladesh which will assist to guide appropriate policy formulation. Data were collected from six districts (Jamalpur, Sunamganj, Satkhira, Chapainawabganj, Thakurgaon, and Meherpur). A total 1316 sample of which 888 sample for rice and 428 sample for wheat were collected from these districts. The study has found that among the stress tolerant rice varieties Binadhan-10, Binadhan-11, Binadhan-12, Binadhan-19, Binadhan-23, BRRI dhan51, BRRI dhan52, BRRI dhan67, and BRRI dhan85 were cultivated by the farmers. The majority of the farmers were pleased with the stress tolerant varieties. In case of wheat, the main varieties that farmers are cultivating include BARI Gom-30, BARI Gom-32, BARI Gom-33, China-3, etc. Farmers are happy with the yield of these varieties. BADC is the main source of supplying seeds to the farmers. In Thakurgaon district, 62% farmers cultivate climate resilient variety and 38% farmers cultivate other varieties. In Jamalpur, Sunamganj and Chapainawbganj districts, farmers who cultivate climate resilient variety and other variety were 49% and 51%, respectively. In Satkhira district, about 44% of the sample farmers were cultivators of stress resilient rice varieties, while the remaining 56% were cultivators of other varieties. Most of the resilient varieties are profitable on cash cost basis as undiscounted BCR are greater than 1. Major factors affecting of climate resilient rice adoption are: variety has traits tolerance to stress, training, farm type, land type etc.

Wheat Farmers' Perception and Attitude towards Adoption of Hybrid Wheat in Bangladesh

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Abstract
Promoting the widespread cultivation of hybrid wheat requires an understanding of the local dynamics as well as addressing socio-economic challenges unique to each context. Hence, the study seeks to identify socioeconomic conditions, factors affecting wheat production, and profitability of wheat production in Bangladesh. A well-designed socioeconomic survey was conducted through a questionnaire by employing the online survey platform (Kobo Toolbox). The study was conducted in ten different wheat cropping districts of Bangladesh (Lalmonirhat, Kurigram, Dinajpur, Thakurgaon, Panchgar, Chapai- Nawabgonj, Pabna, Naogaon, Rajshahi, Joypurhat). The results found that respondent farmers have completed 8 years of schooling on average. They have 12 years of experience in cultivating wheat. Individuals manage and cultivate in total 3.12 acres of land in total, in which 1.02 acres of land dedicated to wheat farming. The age distribution of farmers is divided into five categories: under 30, 31-40, 41-50, 41-60, and over 61(Figure 3). Farmers between the ages of 31 and 40 comprise the majority of the group (49). The vast majority (62.75%) report extension agents as their main information source. About 22.06% of farmers get their information from other farmers, indicating the value of peer learning within the community. Approximately 6.37%, said they get information from companies that provide agricultural inputs. Regarding the factors that can motivate farmers for adoption hybrid wheat seeds, majority of respondents (56.05%) prioritize the goal of achieving more

yield from hybrid wheat seeds whereas 37.90% of farmers emphasize the desire for increased profit. On the other hand, high cost, high risk of failure and difficult to grow found as the main barriers of adoption. Farmers have high perception about the cost of hybrid seed (92.45%), germination rate of hybrids (99.37%), yield of hybrids (99.37%), income from hybrid production (99.37%) and market demand of hybrid wheat (86.16%).

The Status of Women Empowerment of Farm Families in Mymensingh Region and Its' Role on Household Level Food Security

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Abstract

Bangladesh is a least developed country, and the overall growth and development of this country is satisfactory. It will take-off to the middle-income country very soon as it has achieved many remarkable goals of Millennium Development Goals and walking in the path of achieving Sustainable Development Goals. But poverty, disempowerment of women and food insecurity are still existed as those have become constraints in the path of sustainable development. Keeping this in mind, the study aimed to estimate the multidimensional poverty status, women empowerment, and household food insecurity as well as the nexus among them of the rural farm households. A sample of 350 farm households were surveyed randomly from the four villages of Mymensingh Sadar Upazila. Popular Alkire-Foster method was used to estimate the Multidimensional poverty status of the households, pro-WEAI was applied to measure the women empowerment and Household Food Insecurity Access Scale (HFIAS) was utilized to explore the household food security. The study found that 39% of the population were multidimensionally headcount poor and the average intensity of poverty was 47% where overall 11% of the population were deprived in total potential deprivation. The standard of living dimension had the highest contribution of poverty. Less than one percent women were found as empowered in the considered domains. Only 18% of the rural farm households were food secured. The study also explored the determinants in each context. From Binomial Logit Regression model, it was found that, number of earning members, large livestock and crop farming could reduce the risk of poverty where large household size magnified the risk. The results from the Poisson Regression model showed that year of schooling of the women, household size, crop farming and migrated members could enhance the women empowerment, while the distance between farm and household could be a barrier of empowerment. The Binomial Logit Regression model showed that year of schooling of household head, saving account of household, having agricultural land, migrated members, increasing farm size and homestead garden could significantly reduce the household food insecurity, where larger households could increase the food risk of food insecurity. Finally, the path analysis showed that four domains of women empowerment were significantly associated with household food insecurity. Overall empowerment was also negative, and multidimensional poverty was also positively related to food insecurity. Women empowerment could also reduce the multidimensional poverty as well. The study concludes that there is a linkage among the poverty, women empowerment, and household food security in rural farm households. Policy formulation for rural areas should be comprehensive and multifaced for sustainable development and further study need to be conduct for more understanding.

Consumers' Preference Attributes for Indigenous and Broiler Chicken in Rural Bangladesh

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Abstract

Consumers throughout the world are becoming more and more drawn to chicken meat, but their tastes and preferences are influenced by a number of elements relating to food quality as well as the personality of the specific consumer. Preference has a strong correlation with demand and price, consumers' food selection is governed by many factors, like culture, religion, lifestyle, diet, knowledge, health concerns and food trends. Keeping this in mind, the overall objective of this study was to determine the socio-economic characteristics that influence consumer's consumption frequency of indigenous and broiler chicken and their willingness to pay for indigenous

and broiler chicken. Stratified random sampling was used to select 350 sample respondents from five villages under Mymensingh district in order to collect data through field survey. Both descriptive and analytical technique were used to attain the objectives. Binary logit regression model was used to find out the attributes that has a significance on consumption frequency of indigenous and broiler chicken. Years of schooling, nutrition knowledge about chicken, safety of chicken, price of chicken significantly influence consumption frequency of the respondents. Multiple linear regression model was used to find out the factors influencing consumer's willingness to pay for indigenous and broiler chicken. Consumers who are more concerned about nutrition were willing to pay 69% more for indigenous chicken and for safety concerns, they were ready to pay 71% more. According to the result, people were willing to pay even more due to the price of broiler and because of the availability of broiler chicken, people preferred broiler chicken 57% more. Other than that, taste of chicken, physical texture, tenderness, cooking time, size of chicken attributes also significantly influenced consumer's willingness to pay for chicken. Finally, some policy recommendations based on the findings of the study were suggested according to consumer's preference attributes. The study suggests to work on availability and price of indigenous chicken to ensure more consumption frequency of the respondents. This study recommends meat producing farmers and entrepreneurs to adjust the quality control measures for broiler chicken so that people can become more convenient towards the nutritional value of broiler chicken.

An Economic Analysis of Sustainable Intensification of Aquaculture in Bangladesh

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Abstract
Aquaculture production is undergoing rapid growth and intensification in several countries of the world including Bangladesh. This study aimed to understand energy transformation among aquaculture systems of different intensities. The specific objectives were to estimate the profitability of different intensities of aquaculture systems, and understand energy efficiency and energy productivity for different levels of intensity of production. The study also identified the knowledge, attitudes, and practices (KAP) of fish farmers. A field survey was conducted at Bhaluka upazila of Mymensingh district and Sherpur upazila of Bogura district, where freshwater aquaculture has significantly expanded over the last several decades. A total of 215 farmers were surveyed and were stratified based on the intensity levels of production (highly intensive, intensive and semi-intensive). The analytical technique involved estimating the profitability of fish for different levels of intensity and an accounting approach that provided basic measures of energy productivity, energy use efficiency, and net energy balance. The profitability analysis showed that higher intensive farms had a comparatively higher profit margin compared to less intensive farms on an average. The energy accounting showed that energy efficiency and energy productivity increased with higher levels of fish production intensity. The KAP study observed that a large portion of farmers had little or no knowledge about nutrients and balanced feed, balanced ratio of the feed ingredients, and feed conversion ratio. Also, a high proportion of farmers were willing to pay more for better-quality feed. The study suggested promoting intensification of aquaculture keeping in mind its impact on the environment and resource use, and providing training for better feeding practices.

Economics of Adopting Solar Irrigation for Rice Production in Selected Areas of Bangladesh

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Abstract
The study was carried out to compare the solar, diesel and electric motor-based irrigation system and profitability of Aman and Boro rice production under different irrigation methods in some selected areas of Bangladesh. A total of 255 samples were included in the study from Kustia, Meherpur, Rangpur, Thakurgaong, Dinajpur district. Primary

data were collected through face-to-face interview using structured questionnaire. The result shows that electric motor-based irrigation using farmers have the highest net return i.e., Tk. 27565.5 for Aman rice and Tk. 49383.96 for Boro rice and BCR is 1.31 for Aman and 1.44 for Boro rice. The IDCOL operated solar irrigation system has a positive NPV, i.e., Tk. 176290.1 per hectare which is the highest and the personally operated solar irrigation system has NPV of Tk. 142002.3, the second highest among other methods. However, electric motor-based irrigation system possesses the highest IRR and BCR, making it the most income generating and profit-making investment. The second and third most income generating investment in personally operated solar irrigation system (IRR=15) and IDCOL operated solar irrigation system (IRR=14) respectively, then diesel engine-based irrigation stands at last. So, after electric motor-based irrigation, solar irrigation is the best option to use in irrigating lands. In case of Aman rice production, the estimated mean technical efficiency score is about 87.4 percent for personally operated solar irrigation using farmers, 85.90 percent for electric motor irrigation using farmers, 76.30 percent for IDCOL operated solar irrigation system using farmers and 56.60 percent diesel engine irrigation using farmers. Personally operated solar irrigation using farmers are the most technically efficient in the study areas as observed. More or less same trend of efficiency score observed in boro rice as well. Among the various problems, high investment cost of solar based irrigation was the most common problem among the farmers. Finally, some policy recommendations based on the findings of the study were suggested for the improvement of this auspicious sector.

The Role of Credit on Mustard Production and Food Security in a Selected Area of Sirajganj District

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Abstract
Credit is a driving force behind increased crop productivity, and food security is essential to the general advancement of humanity. The current study was carried out to analyze the socioeconomic profile of the respondents, examine the loan components, evaluate the effect of credit on mustard production, and find out how many calories each household member consumes on a per capita basis. A sample size of sixty respondents was selected randomly from Sirajganj district in Bangladesh. Primary data were collected through a field survey using a semi-structured interview schedule. Descriptive statistics, the multiple linear regression models, and the modified OECD scale were used to analyze the data. The study found that most of the respondents were in the active age group, and half of the respondents had a secondary level of education. About half of the respondents belonged to the middle-income group. Two-thirds of the respondents received a large loan. It was found that credit had a positive impact on mustard production. The poverty rate was much higher than the national average in the study area. Along with specialized banks, other financial institutions should extend agricultural loans to increase mustard production and food security for rural poor households in Bangladesh.

Efficiency of the Cauliflower Cultivation in a Selected Area of Gazipur District

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Abstract
Cauliflower, a pivotal winter crop, is cultivated widely in Bangladesh. This study was conducted to assess the socioeconomic characteristics and to explore the farmers' efficiency of cauliflower production in Gazipur district of Bangladesh by applying the stochastic production frontier approach. Primary data were collected through a field survey of 60 cauliflower farmers from January to March 2023, using a semi-structured interview schedule. The major findings of this study revealed that 95% of the respondents were aged between 30 and 64 years; 48.33% of households had a small family size; and 86.67% of the respondents' primary occupation was agriculture. Cauliflower production was profitable. Per hectare total cost, total return, gross margin, net return, and benefit-cost

ratio (BCR) were Tk. 286112, 386250, 138218, 100138, and 1.35, respectively. The mean farmer's technical efficiency was 90%, which implies that the household cultivating the cauliflower can increase revenue by 10% at a given level of resources. Cauliflower farmers complained of a lack of quality seed, the high price of quality seed, natural calamities, and attacks of pests and diseases. Cauliflower is one of the important vegetable crops grown by farmers, mainly to generate household income. The study area has tremendous potential for cauliflower production.

Survey on Chicken Meat Products Available in Bangladesh: Issues and Policy Responses to Extend Its Markets Disregarding any Pandemic Situation

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Abstract

This study aims at assessing the impact of chicken meat products and its market on employment generation and income earning by food industries, fast food shops and restaurant owners and employees. The project has been started in February 2022 in Dhaka and Chattagram. Based on information from specialized meat companies, fast food shops, special restaurants and super markets through surveys, it tries to assess impact of chicken meat products on employment and income generation, preference for chicken meats by consumers. Poultry sector contributes 37% of total meat production in Bangladesh. This sector contributes about 22-27% of the total animal protein supply in the country. Chicken meat products are produced by varieties brand name of different companies and these products are available in their own respective outlets or super shops of big cities. In fast food shops or departmental stores, products are made by their own technologies. Fried chicken, chicken burger, chicken sandwich, chicken roll, chicken cutlet, chicken kebab, chicken samosa and chicken singara are very popular in fast food shops whereas chicken sandwich, chicken burger, chicken roll, crispy and spicy chicken fry are very common in departmental stores. In restaurant, the most common items are grilled chicken, chicken curry, chicken paratha, fried chicken, fried chicken wing, fried chicken drumsticks, chicken with cashew nut, sliced chicken with capsicum, sweet and sour chicken, fried boneless chicken, boneless chicken gravy, masala chicken curry and chicken chilli dry. The process of making variety of chicken products and branding are going on by different producers. Important chicken meat products available in the market are sausages, nuggets, meatballs, spring roll, samosa, singara, cutlet, kebab, burger, sandwich, sharma, lollipop, wonton, grilled chicken, fried chicken. These products are available in ready to eat and ready to cook forms. There are 28-30 Companies those are producing frozen foods (Chicken) like ready to cook and ready to eat. They are Pran, Kazi Farms, Golden Harvest, BRAC Chicken, Aftab Foods, AG Foods, Rich Food, CP, AG Agro, Paragon, Bengal Meat, EON, Country Natural, Quality Foods, Jhatpot, Nourish, Lamisa, Urosia, etc. In Chattogram city, some of the companies like Roja, Tava, Mafco, Essentials, Busket, Swapno are producing chicken meat based frozen foods. Golden Harvest started production and marketing of frozen food (Chicken) products from 2006 in the country. The markets of safe chicken meat products are gradually being expanded over the years. Packaged frozen food products are now being produced and marketed considering consumers' preferences and demands. Several millions of trained people are engaged in the above organizations to produce and sell of chicken meats and earn a handsome amount of money and improve their livelihood. The meat products produced by 14 big companies is 459 tons per month and average return and profit earned are respectively BDT 470 crores and BDT 147 crores in the year 2022. Average profit earned by fast food shops in a year is BDT 432884 and average profit earned by restaurant owners is BDT 1465497.

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Impact of Using Rice Combine Harvester on Postharvest Losses and Food Security in Bangladesh

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Abstract
Bangladesh is a disaster-prone and high vulnerable climate change area. Rice harvest systems faced challenges in different periods due to prolonged rainfall, flash floods, cyclones and other disaster which may create losses in different stages of harvesting. This study has tried to assess the impact of rice combine harvester introduced by the Bangladesh Government on postharvest losses. A pre-tested structured interview schedule has been used to collect primary data of total size 280 households which have been selected randomly from the two study areas Kishoregonj (118) and Naogaon (162) district. Descriptive statistics indicate that most of the farmers used three types of combined harvesters. Simultaneous equation system and regression model were used for the analysis. Descriptive statistics showed that most of the farmers have used a combined harvester on loan. The positive impact of combine harvester technology on the post-harvest loss, food security and socio-economic conditions of harvest workers is the emergence of new livelihoods as wage laborers for rice drying activities while the negative impacts of combine harvester technology on the economic condition of harvest workers are conflict between farmers and harvest workers and loss of their jobs as harvest workers or becoming unemployed workers. It can be concluded that the amount of time spent in work or labor allocation on the rice farming of swamps carried out by the farmers using combine harvesters is smaller than that of the non-users. Therefore, policymakers should emphasize particularly those identified factors to promote mechanized agriculture.

Production Risk, Technical Efficiency and Consumer Behaviour of Poultry in Bangladesh

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Abstract
In Bangladesh, poultry production is a promising dynamic sector with enormous potential for poverty reduction and income generation for the rural households. Poultry meat has a great demand as compared to other meat, because of its low price and the religious taboos in case of pork and beef. Despite its impressive growth and demand, production is highly volatile across farms and location, indicating that output risk may be a problem in poultry farming. By employing a stochastic production frontier model with flexible risk specification on cross-sectional data from 200 sample farms, this study quantifies the production variability of poultry farming from two main possible sources: production risk and technical inefficiency. Main findings are that significant production risk and technical inefficiency exist in poultry farming. Birds or flock size is found to be a risk-increasing factor while feed, housing cost and operational cost are identified as risk-reducing factors. The average technical inefficiency for poultry farmers was found to be 90%, which implies that there is also a potential for reducing production variability by using inputs more efficiently. In inefficiency function, extension services and training are identified as important determinants for the variation in inefficiency. Both extension services and training are significantly increase technical efficiency of the farmers. The study also investigated consumers' preferences and perceptions for poultry meat; to estimate the consumers' willingness to pay for poultry meat. A survey including a choice experiment was conducted. Consumers were considered indigenous chicken meat as being safer, no harmful effect, better taste and more nutritive value and would like to pay a premium for those products. Government policy should focus on increased extension services and training for poultry farmers.

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Resilience and Coping Strategies to Food Insecurity Among the Farm-Households in Rural Bangladesh

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Abstract
Food security is a crucial global issue, as it ensures freedom from hunger and provides access to sufficient, safe, and nutritious food. Resilient food systems keep output steady, adjust to changing circumstances, and guarantee that vulnerable populations can access food. In Bangladesh, where people heavily depend on agriculture, food insecurity poses a significant threat to the well-being and livelihoods of its population. Building adaptive capacities (AC) and addressing underlying causes are necessary for sustainable resilience. The Resilience Index Measurement Analysis (RIMA II) approach was used to estimate resilience capacity to food insecurity in the presence of shocks. In this paper, factor analysis and structural equation modeling were used to estimate the resilience capacity index (RCI). Proceeding from this discovery, we examined further the critical components of household resilience. Next, it is determined whether the estimated household RCIs accurately reflect the household's resistance to food insecurity. Following the determination of the impact of shocks and coping mechanisms on the resilience capacity index, applying the cumulative approach in the proportional odds model for an ordinal response variable. The findings suggest that all pillars are positively correlated with the RCI, with education being a key contributing variable to enhance AC. Policymakers and organizations can learn how well a community can recover from hardship by using resilience assessments.

Role of Livestock in Women's Nutritional Security Status: Evidence from Rural Bangladesh

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Abstract
Women in every household shape the base of food and nutrition-related dimensions and play the major role of ensuring nutritional security for all other members. However, the woman herself has found staying in a vulnerable place in the context of her nutritional security status. Keeping this in mind, the study aimed to estimate the status of women's nutritional security status and explore the determinants of the status. Secondary data has been extracted from the Bangladesh Integrated Households Survey 2018. A total of 5604 women were considered, and their nutritional security status was measured from their dietary diversity score and calorie consumption in 24 hours. Also, a subset of data has been compared with the main data set to explore the impact of livestock ownership on women's nutritional security status. It has been found that approximately 10% of women are nutritionally secure. The binomial logit regression model is utilized to explore the significant predictors and found that livestock ownership, women's education level, household size, the income of the household, farm size, owning a mobile phone by women, and her nutritional knowledge could significantly increase her nutritional security status. The Subset of the data shows that women from households that have livestock have a higher coefficient value than the entire data set, which represents the role of livestock production in securing women's nutritional status. The findings of the study will assist in designing and formulating policy and development programs to enhance women's nutritional security status.

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Comparison of Fish Marketing System in Selected Areas of Mymensingh District

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Abstract
The study aimed to explore the marketing dynamics, profit margins and the efficiency of chosen fish varieties in specific regions of Mymensingh district. The study spanned from October 2021 to December 2021, covering various markets within Bangladesh. Three fish types (Shing, Rui and Pabda), 40 fish farmers, and 152 intermediaries all were chosen purposively. Primary data were gathered through face-to-face interviews. Descriptive statistics, least significant difference, and Shepherd and Acharya methods were employed for analysis. Three marketing channels were identified in the study area, involving fish producers, Aratdar, Aratdar cum wholesaler, Bepari, hawker, retailers, and ultimate consumers. Bepari incurred the highest marketing cost, primarily attributed to transportation costs. Significant differences in marketing costs were observed between Aratdar cum wholesaler (for Pabda and Shing), Bepari with Aratdar, Aratdar with hawker and Aratdar cum wholesaler (for all fish types) across all types of fish. The Shing fish exhibited higher profit margin in marketing across intermediaries, except for Bepari. Significant differences in marketing margins were found between Aratdar and Bepari, Aratdar cum wholesaler, hawker and retailer for all three fish types. Retailer marketing margins differed significantly between Rui and Shing fish, Pabda and Rui fish, and Shing and Pabda fish. The Shepherd's method indicated higher efficiency in marketing in channel 1 compared to channels 2 and 3 for all fish types. Therefore, policy makers should design and implement targeted policies aimed at ensuring fair market access for fish producers and intermediaries.

Women Empowerment through the Participation as Entrepreneur in Textile Handicraft Business: A Case Study in Jamalpur District

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Abstract
This study aimed to investigate the motivational factors of women entrepreneurs choosing textile handicrafts business, measure women's empowerment in economic, household, and mobility decision-making, explore factors influencing women entrepreneurs' involvement in decision-making, and identify the challenges encountered during business initiation and management. A sample of 120 women entrepreneurs was selected using purposive random sampling to accomplish these objectives. Face-to-face interviews were conducted between October and November 2022 to collect primary data. A 22-items scale was developed to assess the factors influencing women entrepreneurs' choice of the handicrafts sub-sector for their business. Following exploratory factor analysis (EFA), 17 items were retained, representing three dimensions: economic, personal and family considerations, and social factors. These dimensions explained 71.866% of the variance, demonstrating high internal consistency with a Cronbach's Alpha of 0.910. Confirmatory factor analysis (CFA) validated the model's suitability. In terms of empowerment, the women empowerment index (WEI) of textile handicraft entrepreneurs was reported to be 0.620, categorized as "moderate empowerment." The linear regression analysis revealed that age group, academic qualification, and income of handicraft entrepreneurs positively and significantly influenced the economic decision-making index. Similarly, marital status, income of handicraft entrepreneurs, and husband’s academic qualification were found to be positive and significant determinants of the household decision-making index. Additionally, marital status and income of handicraft entrepreneurs emerged as significant determinants for the physical mobility index. Throughout their entrepreneurial journey, women entrepreneurs faced critical challenges such as high input costs, limited access to timely business information, a shortage of female role models, and difficulties in obtaining business support. To mitigate these challenges and promote sustainable business development, recommendations included improving access to finance, market linkage, government support for sustainability, and creating networking platforms for women entrepreneurs.

The Assessment of Post-harvest Losses & Processing Opportunities of Jackfruit at Valuka Upazilla in Mymensingh

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Abstract
This study was conducted to examine post-harvest losses and their factors for jackfruit marketing. The study focused on farmers, beparis, wholesalers, aratdar-cum-wholesalers, and retailers in Bharadoba, Birunia, and Kachina unions of the Valuka Upazila. The sample size was 120, including 30 farmers, 25 wholesalers, 5 aratdar-cum-wholesalers, 30 beparis, and 30 retailers. Primary data were collected through face-to-face interviews from mid-August to September 2022. The highest average post-harvest loss was Tk. 136,500 for aratdar-cum-wholesalers, while wholesalers, beparis, and retailers experienced losses of Tk. 66,606.18, Tk. 24,659.56, and Tk. 37,317.19, respectively. Several factors contributed to post-harvest losses, including loading-unloading, carrying, grading, packaging, storage loss, delay in selling, and spoilage. The Tobit Regression Model revealed significant coefficients for factors such as loading-unloading, carrying, grading, packaging/bundling, storage loss, delay in selling, and spoilage losses. These factors had an impact on the total post-harvest losses at a 5% level of significance. Jackfruit offers various processing opportunities, including canned jackfruit, jackfruit nectar, jackfruit chips, and more. However, processing in Bangladesh faces constraints such as inappropriate market access, limited knowledge about jackfruit products, lack of finance, transportation, and storage facilities. Effective marketing policies and support for agro-processing industries can help overcome these constraints and encourage the production of processed jackfruit products. This study provides valuable insights into the price, consumer demand, and processing opportunities related to jackfruit.

Changing Livelihood and Cultural Assimilation of the Garo Community in Bangladesh

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Abstract
This study was conducted on the indigenous Garo community living within the Madhupur areas of Tangail district and consisted of 180 sample households. Primary data were collected from the respondents through a sample survey with the help of an interview schedule and descriptive statistics to analyze data. Annual income has changed in 56.74 per cent of livestock and poultry-rearing households, and 92.08 per cent has changed in fruits and vegetable producers. Financial capital like Cash in hand, cash in the bank, and savings were increased by 71.6 per cent, 53.5 per cent, and 38.5 per cent respectively in livestock and poultry-rearing households. Study shows that education, health status, knowledge and skills and leadership were good for 43%, 52%, 49% and 37% of the respondents, respectively and about 87% of the respondents had cash in hand, about 73% of the respondents had savings, about 42% of the respondents had poultry birds, 32 % of the respondents had livestock, about 51% of the respondents had gold or silver ornament and 78% of the respondents invest credit in their productive farm. The study shows that 54 % 37% 45% 33% and 52 % of respondents reported their education, training, knowledge and skills, leadership and health status are high respectively whereas 36%,48%, 38% 40% and 31% reported medium level. After marriage, nowadays the male Garos are not interested in moving to his wife's parents' home; rather they are living in an independent home. Study shows that 114 couples have built their house away from the husband's or wife's parents, 46 are staying in the bridegroom's house but are independent, 43 couples are staying in the bride's house but are independent, 61 are living away from the bridegroom's house. Most of the Garo who have been converted to Christianity exclude the village council completely. It is a major change caused by a change of religion. The specific lifestyle of the Garo population must be preserved through proper documentation and Governmental recognition.

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Agricultural Development Philosophy of Bangabandhu and Its Impact on Food Security in Bangladesh

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Abstract
Bangabandhu's vision was clear, challenging and reality-based. The leader put special importance on practising integrated agriculture. This paper aims to synthesize the agriculture and food security policy in terms of Bangabondhu's development philosophy. The study followed survey research with the qualitative and quantitative analytical techniques approach and used 360 sample respondents in the Charland area in Mymensingh district through a random sample technique. Average yearly income was 264000 tk, 167000tk and 189000 tk respectively cereal crop, vegetables and poultry rearing activities. Crop producer average income was higher among all groups. The findings show that about 53% of female-headed households adopt and use more indigenous implements in land preparation compared to 28 % of male-headed households. It is also revealed that male-headed households are the greater adopters and users of newly adopted equipmentin land preparation 55% of male and 36% of female-headed households do the same. Household dietary diversity scores of these three groups are cereal crop producers 8.86, vegetable producers 8.54 and poultry rearing 9.15. The family size of a household has a positive coefficient is 0.16 and is highly significant and the experience of modern technology of respondents has a positive coefficient of 0.492 and ishighly significant. The perception index scores indicate that women play a vital role in agriculture as 3rd statement has scored 252 and is ranked 3rd among all statements. Apart from this a large number of respondents positively agreed on having permission from their husbands to get engaged as economically active participants in agriculture as 2nd statement has scored 225 and is ranked 6th among all statements. To enhance technology adoption by farmers, policymakers and developers of new technology need to understand farmers' needs as well as their ability to adopt technology for the attainment of women's empowerment and food security.

Impact of Income Generating Activities on Livelihood Diversification of the Charland Women in Bangladesh

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Abstract
This study examined the level of livelihood diversification and the factors of livelihood diversification of charland women in Mymensingh district. The primary data were collected from four villages of Mymensingh Sadar by adopting simple random sampling procedures. A face-to-face interview was conducted to collect data of a total of 120 respondents in which semi-structured and pre-tested questionnaires were used. Descriptive statistics, Simpson diversification indexing, and Multiple regression analysis were employed for analyzing the data following the objectives of the study. The socioeconomic attributes of different respondents indicate that the characteristics of sampled respondents differ from each other in respect of their age, gender, literacy rate, land holdings, credit access, etc. However, in Charland, a considerable number of women have diversified their livelihood at different levels through several income-generating activities. Findings of the study indicated that (17.5%) had medium livelihood diversification and (10.8%) had high livelihood diversification though (60.8%) of the women had no diversification. The multiple regression model was used to analyze the determinants and find that several factors either positively or negatively affect the extent of livelihood diversification. Education, extension contact, and ICT technology user had positive and significant effects on women's livelihood diversification. A context-specific comprehensive development program is needed to create opportunities in the charland areas to improve women's livelihood resilience.

Women's Entrepreneurship in a Multi-challenged Context: An Attempt Towards Empowerment and Psychological Well-being

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Abstract
Women in developing countries try hard to break the impediments by launching entrepreneurial ventures. Exploring what traits women follow to become entrepreneurs is crucial to promote their entrepreneurship. We explore how Bangladeshi women entrepreneurs' personality traits and trust influence their business performance and the impact of such performance on their empowerment and psychological well-being. Data were collected through a survey using a structured interview schedule from 161 randomly selected Bangladeshi women entrepreneurs running micro-and-small businesses like parlours, food and baking, tailoring and trading of boutiques. Empirical results based on a structural equation modelling reveal that internal locus of control and trust positively predict women entrepreneurs' business performance and such performance contributes significantly to their empowerment and psychological well-being. Women's empowerment positively impacts their psychological well-being. Evidence from the research suggests that entrepreneurship can attain and sustain women's desired empowerment and decent mental health. Therefore, women can pursue their dream through entrepreneurship, which can promote their empowerment and psychological well-being on a high note. They should develop personality traits early in their education to pursue their entrepreneurial career and become empowered. The policy option is to train them to learn how to develop personality traits within themselves and to what extent they should trust their employees to make their businesses successful.

Smart Phone Usage among University Students in BAU: Impact on Physical, Psychological Well-being and Academic Performance

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Abstract
Smart phones are a way to engage in interesting activities such as browsin the internet, playing games, conducting research and taking and sharing photographs. Smart phone make our lives easier, but on the other hand, it ties us. Whenever a habit is converted into an obligation, it becomes an addiction (Alavi et al., 2012) and smart phone use is possibly the biggest non-drug addiction of 21st century. The objective of the study was to investigate the extent of using smart phone among the students of BAU and find out the effect on physical and emotional wellbeing as well as relation with their academics. A sample of 200 students have been selected from six faculties of Bangladesh Agricultural University. Data have been collected with a 26-item Smartphone Addiction Inventory (SPAI) Scale (Lin et al., 2014) from February, 2022 to May, 2022.The highest percentage of students (12.5%) was found to use the smart-phone was 4 hours in weekdays and 17% students used it as 6 hours in weekend. The students use the smart phone for internet browsing (20.5%), time spend with family and friends (14%), entertainment (20%), game (4.5%), social media (38%) and others (3%). It helps in the study (26.5%). For overuse of smartphone, morning class drop-out (12%), lessen study hour (16%), can't concentrate the study (21.5%), feeling stressed (13%), memory loss (11%) also happened among the students. They suffer from eye strain (18%), headache (26%), back pain (7.5%), neck pain (11.5%), muscular contraction (11.5%), obesity (8.5%), memory loss (16.5%) and finger dysfunction (4%). They also suffer from psychological problems like stress (24%), anxiety (17.5%), loneliness (9.5%), depression (17%), social isolation (14%), low self-esteem (5%) and insomnia (13%). Proper initiatives should be taken to control the smart phone addiction.

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Online Education System During COVID-19 Pandemic in Bangladesh Agricultural University: Prospects and Challenges

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Abstract
The objective of this study was to investigate the effectiveness of online learning system in Bangladesh Agricultural University. As an academic (first-hand experience), this study has tried to find out the benefits and difficulties of virtual education system experienced by learners and academicians during the pandemic. Students and teachers' perceptions were required on different perspectives for online learning. Most of the students showed positive approach towards online classes as this is flexible for learners and instructors. Students can listen well-structured content with recorded videos as many times needed. However, from the view of teachers and students' online classes are also challenging compared physical classroom because of the technological constraints, digital divide, insufficient data pack to access the material to attend the class, poor connectivity, lack of device, poor learning environment, technophobia, delayed response, and incapability of the teacher to handle efficiently the material and communication technologies. Despite all these issues, as an online path virtual learning is measured productive and effective for the learners. It is likely that after the COVID-19 pandemic calms down, there is a continued rise in learning schemes using online platforms for study aids, as well as students accepting online education for their higher education.

Nexus Between Women's Empowerment in Livestock Index, Food and Nutrition Security in the Small Livestock Farmers in Bangladesh

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Abstract
Women's empowerment in the livestock sector is a crucial pathway to reducing household poverty and enhancing household food and nutrition security. The study aimed to examine the relationship between women's empowerment and food and nutrition security among livestock farmers in Bangladesh. Convenience random sampling techniques were used to collect a total of 800 cross-sectional data through survey schedules in Bangladesh. Descriptive statistics, inferential statistics, and simultaneous regression models were used to analyze the data. First, the researchers measured women's empowerment using the Women's Empowerment in Livestock Index (WELI), which is designed to assess the impact of livestock interventions on the empowerment of women involved in the livestock sector. The WELI was developed using six crucial domains of women's empowerment. These domains include decision-making in livestock production, decision-making related to household nutrition, access to and control over resources, control and utilization of income, access to and control of opportunities, and workload and control over own time. It can enhance household livelihoods and nutrition while promoting progress on gender equity. The household food security access scale was also applied to measure food security. The study found that livestock interventions have a significant positive impact on WELI. Women's empowerment in livestock production has been shown to have a positive effect on household food security and nutrition. The results also indicate that livestock interventions have increased livestock technology adoption and have a significant positive relationship with household wealth, food security, welfare, and women's empowerment ($p < 0.01$). Developing programs and policies to improve various domains of women's empowerment requires a focused policy agenda that brings together policymakers from different sectors, including education, economy, communications, technology, and agriculture. Women's empowerment has the potential to bring positive changes not only in food and nutrition security but also in all aspects of family health and well-being. The researchers suggest exploring livestock intervention through nutrition-sensitive programs that specifically target women's empowerment in livestock production and nutrition decision-making to improve food and nutrition security. Government agencies, international organizations, and development partners should implement development programs that target female livestock farmers to improve women's empowerment, food security, and nutrition in Bangladesh.

CHAPTER V

Faculty of Agricultural Engineering & Technology

To Propose a Multipurpose Pump House for Coastal Areas of Bangladesh

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Abstract
A pump house with all facilities help to meet basic human needs is a crying need for our farmers and operators to lead a healthy life, cope with weather and climatic change, mitigate loss during natural calamities and serve the nation and the family with an expected period. Aim of this study was to identify the challenges and expectations of traditional pump house stakeholders' and to propose a multipurpose pump house for Coastal areas of Bangladesh with computer aided design layout. The research work has been done by interviewing the stakeholders'. In Coastal area, the irrigation process is maintained by the local farmers by the help of Bangladesh Agricultural Development Corporation (BADC) in some cases and every pump belongs to a pump house. To lift up surface water from rivers and natural canals it require pumping elements. There are mainly two types of pump house such as pump house for diesel operated engine and pump house for electric motor operated pump machine. There was no sanitation facility with pump house. So, the farmers can not avail the opportunity to use toilet. There is no shelter house during thunderstorm. So the fatality rate increases day by day. A pump house has been proposed providing with a toilet and operators room. Primarily, it has appeared that the initial expenditure of a modern pump house is very high. Nevertheless, it supports bringing a momentous change in the sustainable development of farmers and pump operators working environment in the Coastal areas of Bangladesh.

Riser Upgradation of Buried Pipe Irrigation System to Avoid its Identified Issues and Challenges

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Abstract
The study aimed to identify challenges associated with the design, construction, operation, and maintenance of risers in buried pipe irrigation systems. Data were collected from farmers, field staff, and management authorities in Netrokona District, Mymensingh, Bangladesh, employing pretested questionnaires and field investigations. The challenges of buried pipe irrigation systems were assessed by inspecting three deep tube wells (DTW) supplying water through buried pipes with approximately twenty-five outlets. These included a DTW with five outlets at Bangladesh Agricultural Development Corporation (BADC), Netrokona, a DTW with fifteen outlets in Bara Kailati village, Netrokona Sadar, and a DTW with nearly five outlets in Bali Bazar, Netrokona Sadar. Site visits revealed that the primary problem with the buried pipe system was water leakage through outlets. Other problems identified included cracks in the underground pipe, cracks in the riser structure around the outlet, jointing issues, and theft of various components. These problems were attributed to inadequate outlet design and mismanagement of the buried pipe system. To overcome all of these challenges, the riser design has been upgraded and a new model has been introduced that may lead the buried pipe to an economic and durable performance, increase the lifetime of buried pipe irrigation system, reduce water losses and provide a very good effect on irrigation structure.

Paddy Leaves SPAD Value Prediction Using Direct Contact Imaging Method

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Abstract
The Soil Plant Analysis Development (*SPAD*) value obtained from the *SPAD* meter directly relates to leaf chlorophyll content. The chlorophyll content is related to nitrogen content means the amount of fertilizer in a crop. Therefore, determining *SPAD* value is directly involved with crop health. Minolta *SPAD* meter can directly measure

this value, a well-established method in the research field for measuring chlorophyll content. Still, this instrument is too costly, which is beyond a farmers' reach in the perspective of Bangladesh. The purpose of this study is to predict the *SPAD* value for paddy leaves using the direct contact imaging method to estimate the chlorophyll content of a paddy leaf. Numerous features were extracted from each image to predict the *SPAD* values. The features were then used as parameters in the multiple linear regression model. The models' performance was evaluated using images captured from a paddy field using a Minolta *SPAD*-502 Chlorophyll Meter. The multiple linear regression model's R^2 and root mean square error (RMSE) values were 0.71 and 3.6512, respectively. Therefore, this result confirms that the direct digital contact imaging method has the potential to quantify the *SPAD* value of paddy leaves accurately. In the future, an Android app will be developed using this value which can directly measure the chlorophyll content of paddy leaves.

Development of a Variable-rate Autonomous Agrochemical Sprayer System for Disease Control in Paddy Field

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Abstract

Agrochemicals are viewed as a cost-effective, labor-saving tool for disease control and crop growth. However, traditional agrochemical application, especially in smallholders' context, resulted in an excessive, injudicious, and ineffective method that raised disease control costs. This study developed a real-time, variable-rate agrochemical spraying system based on paddy leaf disease severity using image processing techniques with necessary open-access sensors to ensure precise chemical application. The study collected five paddy plants with different leaf disease levels of *BRRI dhan29* variety from on-farm paddy field that was placed in a container in lab condition, with an envision to implement this preliminary lab trial in on-farm smallholder arable farming context. The developed automated cart with variable-rate sprayer was positioned behind the line of plants and switched on, and moved systematically along the line of plants. The integrated camera on the cart captured images and stored them in the Raspberry Pi for further analysis. The study found 34% to 42% of the infected leaf area through image processing. The discharge volume was obtained on average with standard deviation of 35.3±0.31, 23.52±0.32, and 9.66±0.16 for 1, 0.6, and 0.2 s pump operation time, respectively. Results indicate that discharge volumes among pump operation times were significantly different from each other. The volume median diameter (VMD) was found at 1056, 1030, and 264 μm with number median diameter (NMD) at 111, 90, and 80 for 1, 0.6, and 0.2 s pump operation time, respectively. The homogeneity factor was obtained at 9.46, 11.43, and 3.3 for 1, 0.6, and 0.2 s pump operation time, respectively. Subsequently, the real-time automated variable-rate agrochemical sprayer will be optimized in field conditions to check technical and economic feasibility that may guide smallholders' agricultural transitions from conventional to precision systems.

Real-Time Potato Grading System Using Machine Vision Technique

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Abstract

Grading and sorting potatoes ensure that the products meet defined grade and quality requirements for sellers and provide expected quality for buyers. Usually, trained human inspectors assess the potato by seeing the potato for a particular quality attribute related to grading. However, there are some disadvantages to applying human inspectors, such as inconsistency and ample time to inspect huge volumes, and expensive labour costs. Therefore, this study aims to construct an automated conveyor system with a machine vision system to acquire moving potato images. Employing an image processing algorithm to extract the area feature from the captured potato images and developing and optimizing an ejection system for real-time potato grading based on the area feature of potato. The

images were acquired using the developed image acquisition system, and size-based algorithm developed using MATLAB-GUI, which was both simple and successful in categorizing potatoes into three sizes based on area, three sizes based on area, achieving accuracy for Large (81.54%), Medium (86.55%), and Small (93.62%). The ejection accuracy was achieved for Small-Medium (84.86%), Small-Large (87.63%), and Large-Medium (93.57%). Finally, when all the potato samples were together, the ejection accuracy was achieved an accuracy of 96.92%. The automated system was demonstrated its potential, achieving accuracy in the grading of potatoes. The prototypes have shown the feasibility and potential benefits of future mechanization in potato grading processes in Bangladesh.

Evaluation of a BAU Solar Dryer for Drying Fruit, Vegetable and Spices in Bangladesh

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Abstract
Drying is a traditional process of removing moisture from agricultural products up-to a safe moisture level for long term storage. Natural convection solar dryer can be a cost effective and hygienic way of drying products in developing countries. This study was conducted to evaluate the performance of BAU Solar Chimney Dryer for drying fruit, vegetable, and spices at the Engineering Workshop, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh, Bangladesh. The spatial and temporal distribution of temperature in the solar chimney dryer, drying performance, the quality of the dried product and economic evaluation of the solar dryer were investigated. Three trials of each product given for the solar dryer and open sun. The cabbage, mango and turmeric samples were pretreated. Solar radiation and relative humidity were varied from 60 W/m^2 to 829.4 W/m^2 and 28.7% to 84.4 %, respectively depending on the seasons. The average drying air temperature and ambient air temperature at different seasons during the experiment was 17.99ºC to 59.17ºC and 16.84ºC to 43.9ºC, respectively. Solar dryer always required less drying time than open sun drying. The drying rate was always higher in solar drying than the open sun drying. The drying efficiency varied from 21.9 to 29.1% (single layer cabbage), 39.12 to 49.1% (multi-layer cabbage), 7.72 to 10.27% (mango) and 17.98 to 33.04% (turmeric). The pretreated dried cabbage and solar dryer control mango sample was more acceptable and solar dried turmeric powder was found best in all trials. The benefit cost ratio of the dryer was 1.04 (local supermarket), 1.8 (export market) and payback period 0.73 year (local supermarket) and 0.4 (export market). This dryer could be suggested to rural farmers for drying seasonal extra fruits, vegetables and spices or organic dried food businessmen who can sell the dried products in supermarket or export market.

E-advise System for Sustainable Use of Combine Harvester

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Abstract
Agricultural mechanization is playing an important role in the gradual transition from traditional subsistence agriculture to commercial agriculture. The effectiveness of agricultural mechanization depends on the efficient management of agricultural machinery. Inefficient management of agricultural machinery may increase the costs of agricultural operations and decrease their profitability. One of the crucial tasks of farm machinery management is to diagnose machine anomalies and fix them within the shortest possible time. Since the owners of the machinery are usually located in remote places and are usually not able to solve problems/anomalies, they often hire experts who are not generally available in remote places. It is difficult for farmers and entrepreneurs to visit experts in-person due to distance, cost, time and inadequate communication facilities. Furthermore, mechanical harvesting using combine harvesters has been accelerated rapidly in Bangladesh in recent years. The number of experts is also insufficient to give advice and services to all farmers and entrepreneurs regarding on-farm problems of paddy/wheat harvesters. The stated problems can be resolved by a telematics/e-advise system, which can be useful both online and offline, 24/7. Therefore, it is necessary to provide a smart real time monitoring system for combine harvester for

progressive improvement and sustainable harvesting of paddy and wheat in Bangladesh. In the study, the prospects and constraints of an e-advise system for combine harvesters have been thoroughly assessed for the Bangladesh context. Automatic and quick diagnosis of combine harvester anomalies and providing real-time decisions to farmers and entrepreneurs using smart phones and IoT-based e-advise systems have also been developed and tested in the field. The study reveals that the e-advise system is an appropriate smart technique for the sustainable use of combine harvesters in Bangladesh.

Design and Development of an Automatic Water Level Controller

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Abstract

Automatic water level controllers play a crucial role in efficient water management. Automatic water level controllers offer a convenient and efficient solution for managing water reservoirs. This project explores the design and development process of such a system. Such systems address the growing need for effective water management in various applications, from domestic water tanks to industrial reservoirs. The core functionality of the system revolves around real-time water level monitoring within a tank and subsequent pump control based on user-defined thresholds. It typically consists of sensors to detect water level, a control unit to process sensor data, and an actuator (usually a pump) to adjust the water level based on control unit decisions. The design considerations encompass selection of appropriate sensors (e.g., ultrasonic), control units (e.g., microcontrollers and logic circuits) and conductive probes. This project discusses potential implementations, ranging from basic on/off pump control to more advanced systems with level display and remote monitoring capabilities. This project emphasizes encompassing circuit design, component selection, and software development for the microcontroller. Programming the microcontroller dictates functionalities like pump activation and deactivation at specific water levels, level indication through displays or LEDs. The development stages encompass meticulous circuit design, considering factors like power management and signal conditioning for sensor outputs. The selection of appropriate electronic components ensures reliable system operation. Software development for the microcontroller involves writing code to translate sensor readings into control signals for the pump and user interface elements. Rigorous testing procedures are paramount to validate the system's performance. This includes verifying the accuracy of water level detection by the chosen sensor and ensuring reliable pump control based on the programmed thresholds. By automating water level management, these controllers can conserve water, prevent overflows, and ensure a consistent water supply.

Development of Trans-Impedance Amplifier Based Pest Control System for Post-Harvest Loss Reduction in Stored Paddy

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Abstract

Rice is the most important stored product in the agricultural landscape of Bangladesh. The preservation of rice faces a significant loss due to the widespread presence of stored pests. Rice weevil (*Sitophilus oryzae*) is the common and destructive pest in stored rice. Numerous approaches exist for repelling stored pests, involving chemical solutions, biological control, and disinfestation through fumigation. However, the practical viability of these methods has been compromised due to their associated costs and environmental implications. As a result, there is an emergent need for exploring alternative, cost-effective, and environmentally friendly pest management strategies to control stored pests in a sustainable manner. This study explored the efficacy of near-far ultrasound as a repellant technique for the rice weevil. The near-far ultrasound technique involved the emission of ultrasonic waves at varying frequencies and creating an acoustic environment designed to deter pests without causing harm to humans or the environment. The near-far ultrasound system was constructed in combination of the microcontroller, waterproof ultrasound sensor, temperature and humidity sensor. After the system construction in hardware level, an algorithm based on C++

language was built to run the system. A multi web-cam system was deployed for monitoring weevils' movement in radiation and non-radiation chambers. A total of 110 live weevils were used for the Boro season, while 100 weevils were taken for the Aman season for the experimentation. The developed frequency range of 33–48 KHz was automatically sent to the transducer and the radiation on weevil was observed through their movement changed during the experimental time. The results from physical experiments showed that no weevils stayed in the line of sight area after 24 hours of experimentation. The number of live weevils decreased from 110 to 23 in Boro season and 100 to 19 in Aman season after 72 hours of experiment in radiation chamber. In term of system effectiveness, result showed that 31%, 76% and 79% were effective after 24, 48 and 72 hours of experimentation. Hence, the developed ultrasonic weevil repellent system can be a practical and sustainable solution for repelling weevils, which mitigates storage losses caused by weevil infestations.

Development of Sensor-based Vertical Crop Production Mechanism for Ensuring Food and Nutrition Security

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Abstract

The rapid urbanization and industrialization in Bangladesh have led to significant challenges in agriculture due to declining arable land and increasing population density. This research outlines the development and implementation of a real-time data monitoring system designed for NFT-based vertical crop production. The methodology involves the development of a hydroponic monitoring system utilizing sensors for pH, temperature, and electrical conductivity (EC). For wireless communication and data transmission, the system employs ESP8266 WiFi Modules, enabling real-time tracking and management. Data is monitored in real-time through the use of the Firebase database. Additionally, a vertical farming framework is constructed, featuring horizontally arranged PVC pipes to support the hydroponic setup. This approach allows for efficient space utilization and facilitates the controlled growth of crops in urban environments. Findings indicate that the average pH value from the sensor was 6.82, compared to 6.66 from the EC meter, resulting in an error percentage of 2.40%. Temperature readings showed an average value from the sensor at 28.71°C, with the EC meter reading at 26.58°C, leading to an error percentage of 8.01%. For EC, data analysis presented an average of 2.06 mS/cm from direct measurements, closely aligning with the EC meter's average of 2.01 mS/cm, indicating a minor discrepancy potentially due to measurement timing or device calibration. The results reveal a generally stable and consistent environment within the hydroponic setup, underlining the potential for automated systems to maintain optimal growth conditions. The small discrepancies noted between experimental and actual data suggest the system's reliability, although they also highlight the necessity for ongoing calibration and validation to ensure accuracy. This research underscores the importance of precise environmental control in hydroponics and offers insights into the practical application of IoT technologies in agriculture.

Design of IoT-Based Automated Monitoring System for Fish Farming

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Abstract

Bangladesh is a riverine country and aquaculture has a significant economic impact on this country. It is an excellent source of inexpensive, protein-rich, and other health-beneficial nutrients. The conventional method required regular site visits, documentation of multiple measurements, and parameter control. The time it took to acquire and analyze data in this manner they have necessitated the development of a new technique to overcome these limitations and make this task more user-friendly. Utilizing Internet of Things (IoT) technology, a water quality monitoring system may be able to solve all issues. In this study, various types of sensors, including pH-4502C, DS18B20 temperature, gravity analog turbidity, TDS, gravity analog DO sensors, are combined with an ESP32 microcontroller to create a monitoring system for pH, temperature, turbidity, total dissolved solids and, dissolved oxygen level measuring in a

pond. The developed system automatically monitors those water quality parameters, displaying data in the Blynk app. The developed system was deployed in the pond to verify and validate its performance. The device is inexpensive and straightforward so that the fish farm owner can increase fish productivity and efficiency.

Design and Development of an Iot Based Solar Pump Controller System

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Abstract

Internet-of-Things (IoT) is ever-present, ranging from home solutions to turning wheels for the fourth industrial revolution. It can be of incredible assistance in improving the creation and yield in the farming division by easing the farm operations. This study aimed at developing an IoT-based irrigation system powered by solar energy. It was consisted of solar-enabled base station with raspberry pi 4 for the controlling of the pump operation. A 20 W solar panel was used to power the system and 12V 7.5Ah battery to store the energy. This source was to enough to run the Raspberry Pi 4 and the 12V, 12.2 W DC irrigation pump. Several data collecting substations were also developed to collect the field data. ESP8266 was implemented to transmit the data to the base station by MQTT method. Considering a 75% discharge at maximum the battery could power the motor for at least 2 hours at night, where battery at data collecting substation was enough to power the system. The irrigation operation was controlled based upon soil moisture, air humidity, and temperature data. The lower threshold value for starting the pump operation was set at 45% where it would stop fulfilling the trained conditions. A website was developed to monitor the real time field data, where the pump operation can also be controlled by the user interface. Several conditions for irrigation was implemented in the system to run the irrigation pump. The irrigation system could run at around 85% efficiency. With the system the farmers will be able to accurately monitor the field condition and control the irrigation from any corner of the world by the developed website. The system will help reducing dependency over conventional energy sources, along with minimizing irrigation water loss.

Design and Development of a Smart Bio-Flock System to Secure Food Safety During Winter

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Abstract

Accelerating IoT-based aquaculture is necessary to close the fish supply gap, particularly in developing countries like Bangladesh. Ineffective technologies and a need for monitoring mechanisms cause low productivity in aquaculture. The proper monitoring and management system is necessary for a bio-secure environment today because of increased productivity and decreased mortality from large-scale fish farming. In order to sustain fish development in the biofloc system, this research built an Internet of Things (IoT)-based system to monitor water quality parameters such as temperature, ammonia, pH, dissolved oxygen, and total dissolved solids. The informations from the DS18B20 water temperature, pH-4502C, analog DO, analog TDS, and toxicity of ammonia sensors were combined using an Internet of Things platform for real-time data analytics. In the winter, mono-sex Nile tilapia was used in three separate biofloc tanks for the experiment. Using the Blynk application, real-time data display on mobile and computer devices was made possible by the ESP32 microcontroller after processing of the data collected from several sensors.As per the research findings, the average temperature,DO, TDS, and pH level were27.82±0.23 °C, 7.73±1.36 mg/l, 308.56±120.4 ppm, and 7.67±0.23, respectively were observed in the biofloc system. The ammonia content was comparatively low, ranging from 0.5 to 0.8 ppm. The temperature range for biofloc fish farming was maintained from 27°C to 30 °C. If the temperature deviates from this range, a signal was sent to the web-based IoT platform Blynk, which then triggers the relay to switch on or off the water heater. In addition, an ammonia sensor was used to regulate the ammonia level following a specific Blink app alert.The aquaculture sector in Bangladesh could be improved by putting cost-effective techniques like biofloc operation into practice during the winter.

Optimization of Agricultural Lands for Different Crops for Sustainable Groundwater Use Under Climate Change Condition in the North-West Region of Bangladesh

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Abstract
Quantifying crop-water requirements and assessing irrigation water demand, while considering crop-usable effective rainfall, is crucial for enhancing groundwater management in the water-scarce North-West (NW) region of Bangladesh. Analyzing the spatial and temporal variability of these factors is essential for promoting sustainable groundwater use in the area. This research utilized the SWBcropwat model to assess the irrigation water requirements of nine key crops (Boro, Aus, Aman, maize, wheat, mustard, potato, mungbean, and sugarcane in Rajshahi, with tobacco instead of sugarcane in Rangpur division) and fifteen cropping patterns. The estimates were derived from local hydroclimatic data spanning the years 1985 to 2015. Also estimated are the groundwater abstraction of the region and their trend with MAKESENS model. The monthly total rainfall showed significant ($p \leq 0.05$) decreasing trend in July except for Dinajpur and Nilphamary districts. The monthly total evapotranspiration also declined with significant trend except for July, September, and October. Crop evapotranspiration decreased significantly except for Aman rice. Groundwater withdrawal showed significantly increasing trend in Kurigram, Lalmonirhat, Nilphamari and Thakurgaon districts but decreasing trend in Bogura and Joypurhat districts. Groundwater withdrawal decreased insignificantly (from 7339 Mm^3 to 6702 Mm^3; 8.7%) in Rajshahi but increased significantly (from 4192 Mm^3 to 4986 Mm^3; 19.0%) in Rangpur division. With increasing crop acreage, the shortage of water resources is becoming increasingly critical in many areas of the region. Considering water scarcity and economic benefit, farmers need to adjust crop selection by shifting from higher-water demanding crops to lower water-demanding crop-cultivation. These results are vital for selecting irrigation acreage and sustainable agricultural planning for the NW region of Bangladesh.

Effects of Water Percolation Management on Rice Yield and Nitrogen Leaching During Aman and Boro Seasons

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Abstract
A large portion of water and nitrogen can be lost through the soil profile in rice fields because of inefficient water management. An efficient percolation management practice in rice fields is yet to be identified. This study investigated the impacts of percolation management on nitrogen leaching and rice yield in the Aman and Boro seasons. The experiment was conducted using field lysimeters with the following treatments: (i) uncontrolled percolation, (ii) reuse of percolated water, and (iii) zero percolation. Irrigation, rainfall, percolation water, plant growth, and yield components data were recorded. Leachate samples were collected at 10-day intervals and analyzed for nitrogen concentration. Zero percolation produced the highest number of tillers in the Aman season, but no variation was observed in the Boro season. Total percolation was 10–13 cm in the Aman season and 20–21 cm in the Boro season. The reuse of percolated water gave the highest 1000-grain weight in both the Aman (21.7 ± 0.9 g) and Boro (21.8 ± 0.9 g) seasons. As expected, zero percolation had higher water productivity (1.8 ± 0.2 kg/m^3 in the Aman season and 1.6 ± 0.2 kg/m^3 in the Boro season). The reuse of percolated water increased NH_4^+ -N (ammonium) leaching (1.1 mg/L) compared to the uncontrolled percolation (0.9 mg/L) in the later part of the Aman season. Leaching concentrations of NO_3^- -N (nitrate) ranged 0.28–8.77 mg/L but did not show any response to the treatments. The reuse of percolated water improved the grain quality. This study will help identify better percolation and nitrogen management options for rice cultivation.

Prioritization of Adaptation Options for Improved Cropping Pattern Transformation under Climate Change in Northwest Bangladesh

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Abstract
The evolving challenge of climate change is expected to reduce the future water availability and thus, will likely put more pressure on existing agricultural systems in Bangladesh. The Northwest region of the country is particularly more vulnerable to climate change due to limited water availability during dry season and high agricultural water demand and drought. Adjustment of cropping pattern may be plausible intervention to reduce annual water demand for crop agriculture. It is important to identify the factors that influence cropping pattern transformation and find-out their interconnection. Also, the comparison of water demand of major crops under recent and future climate scenarios is vital for the anticipatory planning for cropping pattern transformation. This study has identified interlink among different factors that affect optimum and practical cropping decisions and listed suitable adaptation options for improved cropping pattern transformation. The crop water requirement and potential irrigation requirement of major dry season crops during base period and future time periods (2050s and 2080s) for moderate (RCP 4.5) and rapid (RCP 8.5) climate change scenarios have been estimated. Results indicate an increase in crop water requirement and potential irrigation requirement of crops for fixed growth duration. Potential irrigation requirement of *Boro* rice would increase by 15% and 20% for moderate and rapid climate change, respectively in 2080s compared to base period for fixed growth duration in Bogura. Experts' opinion has been collected to identify most suitable cropping pattern and prioritize identified adaptation options. The finding of this study would assist decision makers for long-term agricultural planning.

Quality Assessment and Environmental Consequences of Dairy Farm's Wastewater Irrigation in Wheat

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Abstract
An experiment was conducted at the Field Irrigation Laboratory of Bangladesh Agricultural University (BAU) to investigate the consequences of dairy farm's wastewater irrigation on wheat production during 14 December 2022 to 26 March 2022. Six treatments were investigated combining irrigation application techniques and water quality. The treatments were- T_1: Conventional irrigation method with fresh water, T_2: Conventional irrigation method with mixed water (fresh water: dairy wastewater= 1:1), T_3: Conventional irrigation method with wastewater, T_4: Alternate wetting and drying (AWD) irrigation method with fresh water, T_5: AWD irrigation method with mixed water (fresh water: dairy wastewater= 1:1) and T_6: AWD irrigation method with wastewater. These treatments were experimented in individual lysimeter having area of 1.2×1.2 m and soil columns of 1 m. Although applied raw wastewater contained high amount of total viable count (TVC), *E-Coli* and Salmonella, leached water collected from lysimeter showed only TVC. The highest TVC of leached water (5.2×10^7 CFU/ml) was found in treatment T_6 at 70 days after sowing (DAS). After harvesting, the highest residual TVC was found (5×10^6 CFU/g) from the top soil of treatment T_3 and T_6. The highest grain yield (4.77 t/ha) and water productivity (2 ± 0.19 kg/m^3) of wheat were found for treatment T_3. The lowest grain yield (2.83 t/ha) and water productivity (0.93 ± 0.07kg/m^3) of wheat were obtained under the treatment T_1. The highest value of plant height (96.06 ± 9.77 cm), spike length (11.44 ± 1.29 cm), number of spike/m^2 (1930), and number of spikelet/spike (36.17 ± 4.27) were obtained in treatment T_3. The lowest value of growth parameters was found in treatments with fresh water irrigation. So application of wastewater increased nutrient content in soil which contributed to growth and yield. Sodium adsorption ratio, soluble sodium percentage, residual sodium bi-carbonate, total hardness and magnesium adsorption ratio of dairy wastewater were found to be suitable for irrigation. It is clear that dairy farm's wastewater can be used as an alternative source of irrigation but it should be used with proper management practices to maintain proper soil health.

Technologies for Improved Water Use Efficiency in Maize Production in Water Stressed Area of Bangladesh

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Abstract
Alternative technologies to increase grain maize production under rainfed systems are urgently needed, considering the low grain yield in small-scale farming in countries like Bangladesh. Supplemental irrigation and tillage methods are considered valuable available farming technologies. This study examined the impact of supplemental irrigation (no irrigation i.e. rainfed as a control, irrigation at 10days interval, irrigation at 20 days interval and irrigation at 30 days interval) and three tillage methods (full tillage, strip tillage and zero tillage) on maize grain yield and water use efficiency. The field experiments were carried out on the experimental plots of the BAU Farm, Block-2 in three replications. Studies on belowground biomass showed that most roots were concentrated in the upper 25 cm of the soil. Tillage had a great effect on soil penetration resistance, but little effect on root growth and a limited effect on yield. Root to shoot ratio was higher under no tillage and rainfed conditions, due to low allocation of assimilates to aboveground traits under water stress. . The highest grain yield (16.77 t/ha) was found in the full tillage and 10-days irrigation treatments and the lowest yield (13.24 t/ha) was observed in the no-tillage and 20-days irrigation treatment. In case of cob length, cob perimeter, 1000- grain weight and no. of grain/cob, no statistically significant differences obtained among various tillage practices. The combined effects of tillage practices and irrigation application did not significantly influence on the most of the yield contributing characters. Water use efficiency ranged from 1.31-1.49 kg/m^3 (rainfed) to 0.39-1.38 kg/m^3 (irrigated). Supplemental irrigation alone resulted in an average maize yield increase of 126% compared with rainfed maize. Overall, the research reveals scope for improving crop water use efficiency in water stressed regions through better soil and water management practices.

Potentials of Crop Models to Quantify Yield Gaps of Dry Season Boro Rice Cultivars

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Abstract
Narrowing the existing rice yield gaps between research stations and farmers' fields can lessen the risk of food insecurity in Bangladesh. Crop models are increasingly becoming popular to predict yield and to estimate yield gap as numerous combinations of management operations can be evaluated, which is not often possible through field experiments. This two-years (2023–2024) study was undertaken to test the capability of DSSAT Ceres-Rice model in simulating BRRIdhan-28 for four different management options. These are combined from two fertilizer treatments (F1: Recommended dose and F2: half of the recommended dose) and two irrigation treatments (I1: continuous flooding (CF), and I2: alternate wetting and drying). These treatments (I_1F_1, I_1F_2, I_2F_1, I_2F_2) with three replications were laid out in 12 plots (4 m × 5m) where a 3 m buffer between two adjacent plots was maintained. For I_1 treatment, a plot was irrigated with 5 cm water after 1–2 days of disappearing of standing water on the plot. For I_2 treatment, the same amount of water was applied in each plot when perched water level drops to 15 cm depth below the ground surface. Soil physico-chemical properties were measured separately for each plot. Various growth and yield parameters were recorded during the experiment period. Daily meteorological parameters were collected from the nearby weather station. The cultivated rice cultivar required 105 and 65 cm irrigation water during the growing period for the I_1 and I_2 treatments, respectively. Average LAI of the four treatments (I_1F_1, I_1F_2, I_2F_1, I_2F_2) at 58DAT were 4.197, 3.859, 3.859, and 3.385, respectively. This indicates that any underdose irrigation/fertilizer negatively affects vegetative growth. Average yields of the four treatments were 4.246, 3.769, 4.348, and 3.421 t/ha, respectively. Using 1st year data, a DSSAT Ceres-Rice model was built to simulate various plant growth and yield parameters for the four treatments.

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Estimation of Water Requirement and Crop Coefficients of Boro Rice under Humid and Warm Climate: Experimental and Analytical Approach

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Abstract
Climatic variability influences crop-water demand and crop production. The integrated effect of climate variables can be measured by reference crop evapotranspiration (ETo) which determines the crop water requirement. This study has estimated the water requirement (ET) and stage-wise crop coefficients (Kc) of Boro rice in Mymensingh with a field experiment in a modern lysimeter combined with an analytical approach to improve the management of water resources in irrigated agriculture under future climate stress. The three treatments were: (i) control - conventional irrigation practice, water application after the disappearance of ponded water; (ii) continuous saturation; and (iii) Alternate Wetting and Drying (AWD) - irrigation applied after 5 days of ponding water disappearance. The reference evapotranspiration (ETo) has been estimated from daily climate data. The adjusted Kc of Boro rice from climatic parameters was found 1.05, 1.13, 1.21, and 0.90 for initial, development, mid-season, and late-season stages, respectively for all the treatments. The average ETo was found 2.34, 3.05, 3.71, and 4.55 mm/day; and the average analytical ET was 2.46, 3.45, 4.49, and 4.10 mm/day for initial, development, mid-season, and late season stages, respectively for all the treatments. There is no significant difference among the three treatments in analytical water requirement of rice. The experimental Kc and ET were found 1.23, 1.37, 1.45, and 1.03; and 2.87, 4.17, 5.39, and 4.68 mm/day in control; 1.09, 1.15, 1.19 and 0.89; and 2.55, 3.51, 4.42, and 4.06 mm/day in continuous saturation; and 1.15, 1.20, 1.27, and 0.94; and 2.69, 3.66, 4.73, and 4.27 mm/day in AWD for initial, development, mid-season and late-season stages, respectively. Less water requirement was found under saturation condition, but it needs to be further studied on water productivity along with growth and yield attributes of rice for selecting the most economical method for water application.

Development of Non-destructive Techniques for Detection of Internal Defects and Fertility of Chicken Eggs Using Visible-near Infrared Spectroscopy and Computer Vision Combined with Artificial Intelligence and Image Processing

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Abstract
As of August 2019, there were 81,425 registered poultry farms. There are 54,411 broiler chicken farms, 18,954-layer chicken farms, and 7,829 duck farms. The annual egg output increased to 17.11 billion pieces in fiscal year 2018-19, with per capita egg consumption reaching 104.23 by 2020. Eggs are utilized in the food business for their different functional qualities, such as foaming, binding, and gelling. Egg internal quality is critical for the egg product sector in order to minimize internal defects and microbiological spoiling of eggs. The study used machine vision and Vis-NIR spectroscopy to identify internal defects in eggs (blood spots, broken yolks, and fecal contamination). Eggs containing blood spots, fecal contamination, and a broken yolk were prepared. The spectra and color images of the control and prepared samples were obtained using a spectrometer and a digital camera. Significant differences ($P<0.01$) were observed in spectral transmission between control eggs and eggs with blood spots, broken yolks, and fecal contamination in the visible spectrum. There was no significant difference in color between control eggs and eggs with broken yolks. The color image of fecal-contaminated eggs differs from control eggs on day 2 of incubation. Multivariate analysis was carried out on the spectral data and color images of control and prepared egg samples to classify eggs with blood spots, fecal contamination, and broken yolks. The results demonstrated that the Vis-NIR spectroscopic approach could detect blood eggs with 98% accuracy on both white and brown shell eggs. While computer vision can detect blood eggs with 92% and 88% accuracy, white and brown shell eggs, respectively. Fertile white shell eggs have been identified using machine vision with an accuracy of 89% and 100% on incubation days 1 and 2, respectively. Nondestructive techniques might be utilized in the industry to detect internal defects in chicken eggs.

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Comparison of the Quality of Mustard Oil Extracted by Two Different Pressing Techniques

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Abstract
The study aims to compare the quality of mustard oil produced by two different pressing techniques, ghani and expeller during storage at different temperatures and to modify the mechanical expeller to get better quality oil. Mustard seeds were pressed using both techniques (ghani and mechanical expeller), and the resulting oils were stored at three different temperatures (room temperature, 4°C, and 37°C) for 12 weeks. The quality parameters analyzed included acid value (AV) and peroxide value (PV). The results showed that the AV and PV of mustard oil increased with increasing storage temperature and time. The oil obtained from the expeller scored more in terms of AV and PV in all storage temperatures compared to ghani oil, but ghani oil stored at room temperature showed less PV compared to the two other temperatures. This may be due to the heat generated during the pressing. A series of thermocouples were placed at various locations of the expeller to measure the temperature during the extraction process. The results showed that the most heated area in the expeller was the discharge end, with an average temperature of 80°C. The temperature gradually decreased along the length of the expeller, with the lowest temperature of 58°C observed at the feed section. The results also showed that the temperature distribution in the expeller was non-uniform. After that, the oil sample was collected from each repeated pressing and the temperature was recorded for each repeated press to justify if there is any relation with temperature rise. The temperature of different parts of the expeller chamber was recorded during repeated pressing of the mustard seed at different locations using thermocouples. The results showed that the temperature of the expeller chamber increased with the repeated pressing of the mustard seed. The temperature of the expeller was found ranging 34.2°C to 39.9°C for the first press. The most heated area was found to be the part next to the oil outlet. This could be attributed to the increased frictional forces and the accumulation of residual seed cake in this area. The results showed that the quality of oil extracted from mustard seeds was better in the first press and gradually degraded with repeated pressing. The free fatty acid content and peroxide value of the oil increased with each pressing, indicating an increase in oxidative degradation. The color of the oil also became darker with each pressing, indicating the presence of more impurities. These findings suggest that repeated pressing of mustard seeds may not be suitable for obtaining high-quality oil.

Extraction of Polyphenols from Mango Peel and Encapsulation of Polyphenols with Milk, Maltodextrin and Gum Acacia

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Abstract
The aim of this research is to extract total polyphenol compounds and assessment of their antioxidant properties from mango peel and encapsulation of mango peel polyphenol (MPP). MPP was encapsulated with milk, gum acacia, maltodextrin and investigated the physico-chemical and storage stability of MPP encapsulated milk powder. Ripe mango peel provides (64.37±0.26mg GAE/g) total polyphenol (TPC) and encapsulated milk powder gives (62±0.26) mg GAE/g) TPC. Antioxidant activity (DPPH) was 52.563% for mango peel extract and 57.693% for encapsulated milk powder extract. Concerning physico-chemical properties of microencapsulated powder milk extract, spray dried powder contained moisture (2.78±0.015%), bulk density (0.48±0.011g/ml), tapped density (0.58±0.011g/ml), flowability (21.19±0.08), cohesiveness (1.25±0.007) and hygroscopicity (0.039±0.0007g/g solids), whereas cabinet dried powder contained moisture (4.47±0.058%), bulk density (0.47±0.006g/ml), tapped density (0.59±0.011g/ml), flowability (20.15±0.007), cohesiveness (1.15±0.007), hygroscopicity (0.025±0.0007g/g solids). The solubility of microencapsulated milk powder was initially 82.83% and 78.77% for spray drying and cabinet drying, respectively and the value decreased over time. Concerning color, the lightness (L*), yellowness (b*) and redness (a*) were decreased for both the samples. Efficiency of microencapsulated milk powder was

measured and spray dried powder (85.08±0.82%) had higher efficiency than cabinet dried powder (77.56±0.44%). Finally, spray dried powder was more stable in terms of TPC retention than cabinet dried powder. At the outset, the TPC was about 74 and 62 mg GAE/g for spray dried and cabinet dried milk powder, respectively. Statistical analysis suggested that there was no significant difference between spray and cabinet drying samples during storage at 4^{o}C but differ at 25 and 37^{o}C for the time period (30 days) studied, in terms of polyphenol retention rate. Results indicate that polyphenol can be encapsulated using a combination of gum acacia 6% w/v and 10% maltodextrin along with milk proteins at 4^{o}C for longer shelf life.

Extraction of Polyphenols from Banana Peel and Encapsulation of Polyphenols *via* Freeze Drying

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Abstract
The aim of this research is to determine total polyphenol compound and antioxidant properties of banana peel extract and microencapsulate with coating materials to investigate physico-chemical properties and storage stability of polyphenol enriched milk powder. Banana peel supplies bioactive substances such as TPC, TFC. The result indicates that ripe banana peel provides (143.663±0.086 mg GAE/100g) TPC, (156.139±0.042 mg rutin/100g) TFC and unripe banana peel supplies (118.232±0.172 mg GAE/100g) TPC, (132.762±0.073 mg rutin/100g) TFC. Antioxidant activity (DPPH) of banana peel was 73.925 and 80.405% for unripe and ripe banana peel extract respectively. Composition of banana peel was also determined and the result was moisture (7.44-8.54%), ash (11.38%), protein (8.41%), fat (9.44%) and carbohydrate (62.23%). Physico-chemical properties of microencapsulated banana peel extract by freeze drying and spray drying was also investigated. The result showed that freeze dried banana peel extract contained moisture (2.82±0.43%), bulk density (0.44±0.02g/ml), tapped density (0.61±0.01g/ml), water activity (0.39±0.02), hygroscopicity (0.029±0.35g/g solids) where spray dried banana peel extract contained moisture (3.29±0.2%), bulk density (0.49±0.05g/ml), tapped density (0.57±0.02g/ml), water activity (0.37±0.01), hygroscopicity (0.043±0.29g/g solids). The solubility of microencapsulated milk powder was initially 88.06±0.13% and 76.87±0.29% for freeze drying and spray drying respectively. This result showed that the solubility decreases over time. Efficiency of microencapsulated milk powder was measured and the result indicated that freeze dried powder (88.06%) had higher efficiency than spray dried powder (76.87%). Statistical analysis suggested that there was freeze drying showed better polyphenol retention rate during storage at 4, 25, and 37^{o}C for the time period (30 days) studied, in terms of polyphenol retention rate. Results indicate that polyphenol can be encapsulated using a combination of gum acacia 6% w/v and 10% maltodextrin along with milk proteins at 4^{o}C for longer shelf life.

Processing and Preservation of Karagula by Fermentation

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Abstract
The Karagula fruit is a seasonal and is available in the selected hilly areas during September to November. Rest of the months of a year it is totally unavailable in the market even at a higher price. Also during peak season a large amount of fruit remains unused which may be treated as spare. So, it is important for the producers as well consumers to make it available as long as possible by using to increase the shelf life by cost-effective technique. That is why; it is of interest to apply few traditional and low-cost techniques for the processing and preservation of Karagula fruit to make it available round the year and in the form of different processed product. The study has been carried out to process and preserve Karagula by fermentation to ensure the diversified use of Karagula. Initial investigation has been conducted to determine the proximate composition of Karagula. It was observed that moisture content varies from 88 to 95%, ash: 1.2 to 1.35%, fat: 0.20 to 0.22, protein: 2.8 to 3.15%, Vitamin C: 35-50 mg/100g, acidity: 0.023 to 0.025%, pH 4.5. The fermentation of Karagula at different brine concentration was

carried out and it was observed that 18 days fermentation period is required for the completion of the process. The acidity and pH was measured during the fermentation period which was varied from 0.023 to 0.032% and 4.5 to 4.05, respectively. Vitamin C content decreased from 44 to 22mg/100g.

Classification of Raw Milk, Pasteurized Milk and UHT Milk by NIR Spectroscopy

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Abstract
The purpose of this study was to evaluate the organoleptic, physicochemical, and microbial quality of different commercial and local milk samples, as well as the presence of any adulterants. Three different brands of ultra-high temperature (UHT) milk, three different brands of pasteurized milk, and three different raw milk samples were obtained and tested for various quality tests. A testing panel of 15 panelists evaluated the organoleptic properties of milk samples to determine consumer preference. The milk samples were subjected to physicochemical, adulteration, and microbial analyses using various standard methods. Most organoleptic properties of UHT and pasteurized milk samples differed significantly at $p \leq 0.05$, whereas raw milk samples were equally acceptable to the panelists in most cases. Raw milk had the highest moisture content (91.01%), while UHT had the lowest (88.10%), and other components included 0.67%-0.79% ash, 3.19%-3.47% protein, 3.16%-3.55% fat, 4.36%-4.65% lactose, 0.14%-0.23% acidity, 6.06%-8.85% solid not fat, 9.30%-12.60% total solid, and 1.026%-1.033% specific gravity. Raw samples failed all adulteration tests, while commercial milk samples passed only the added sugar test. Total standard plate count and coliform count tests revealed no detectable microorganisms in commercial milk samples, despite the presence of a significant amount in raw milk samples. Despite some variations in some parameters of the three milk categories, this study concluded that UHT and pasteurized milk were of excellent quality. The classification result on the basis of physico-chemical properties is very poor and is close to 10% which is not acceptable. Hence, classification has been emphasized on the basis of Spectral responses obtained by NIR spectrometer. Using Vis-NIR spectra, Pasteurized milk with different % of adulterants (1:0%, 2: 5%, 3:10%, 4:15%) can be classified in the range of 88% to 100% whereas from the same approach, the raw milk, pasteurized milk and UHT milk can be classified 100%.

Encapsulation of Orange Peel Polyphenol in Oil in Water Emulsion

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Abstract
Orange peel extract is frequently used as a food coloring ingredient and comprises bioactive substances like antioxidants. The objective of this study was to extract phenolic compounds from orange peel and encapsulate them in buttermilk to evaluate the physical properties and shelf life of buttermilk. Three different solvents (80% ethanol, 80% methanol, and water) were used to optimize the polyphenol extraction. The aqueous orange peel polyphenols (OPP) were encapsulated in buttermilk. The ratios between OPP and gum acacia were 1:10, 2:10, and 3:10 (w/v). 10% (w/v) maltodextrin (DE 18) was added to suspension and homogenized. Encapsulation efficiency (%EE) was assessed for capsules while physicochemical and microbial parameters of buttermilk were assessed during refrigeration storage at 4 ± 1□ (fresh, 5, 10, and 15 days). The ethanolic extract had the highest extraction yield (25.57%), total phenolic content (130.6 mg GAE/100 g), total flavonoid content (85.26 mg RE/ 100 g), and DPPH levels (79.32%). Increasing the amount of OPP and gum acacia ratio greatly enhanced the buttermilk's phenolic contents and antioxidant activity. A higher EE (95.20%) was observed when using OPP: wall materials at the proportion of 3:10. Increasing the proportion of OPP in the polyphenol-enriched buttermilk decreased the pH, total viable count, total coliform count and increased titratable acidity and total soluble solids. Color analysis suggested that increasing the OPP decreased the color parameters of the encapsulated buttermilk. However, the addition of OPP had no appreciable influence on the sensory qualities of buttermilk. This study evinced that OPP can be used to enrich polyphenols and increase the shelf life of buttermilk.

Development and Quality Evaluation of Orange Peel Polyphenol Enriched Dairy Product

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Abstract
Orange peels (OP) as a fruit waste is a rich source of phenolic compounds. The research aimed to extract phytochemicals from OP by solvent extraction method and to investigate the effects of phytochemical on the physicochemical and microbial quality of the fortified yogurt. In this study, ethanol, methanol, and acetone were used to optimize the total yield, total phenolic, flavonoid, and antioxidant activity of the extract. The ethanolic extract of orange peel demonstrated the highest extraction yield (25.06%), total phenolic content (128.5 mg GAE/100g), total flavonoid content (86.38 mg/100g) and DPPH contents (77.35 ± 0.06%) in comparison to other solvent extracts. The ethanolic orange peel polyphenol (OPP) was used for the fortification of yogurt at 0.5% (S_1), 1.0% (S_2), and 1.5% (S_3) respectively, compared with control (S_4) during 15 days of storage at 4□. Functional yogurt with 1.5% OPP contained a higher amount of total phenolic, flavonoid and antioxidant activity. The extracts had also a significant (*p≤0.05) effect on pH, titratable acidity, reducing syneresis, and increasing water holding capacity (WHC) throughout the storage periods. Among the fortified samples, S_3 showed lower pH and syneresis with higher WHC, total soluble solids compared with others throughout the storage where titratable acidity did not influence significantly (*p≤0.05). Increasing the proportion of OPP caused the polyphenol-enriched yogurt to have a lower total viable count, and total coliform count. The color parameters were significantly affected compared to control sample. The sensory quality was almost identical to control samples in terms of color, flavor, texture, and overall acceptability. According to the findings, S_3 was the best of all the treatments, taking into account all parameters. This study evinced that OPP enriched yogurt have a potential source of phenolic compounds, which could be utilized as fortified dairy product with high nutritional content and high acceptance.

Efficacy of Natural Additives on the Quality and Shelf-life of some Selected Fresh Cut Fruit and Vegetables

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Abstract
Fresh fruit and vegetables are very much perishable and richest sources of phytochemicals and bioactive compounds. The importance of fresh-cut produce lies in its major characteristics of freshness, convenience, nutrient retention and sensory quality while providing extended shelf life. This research aims to find out the effectiveness of natural additives on the quality and shelf life of fresh cut fruit (mango and strawberry) and vegetables (carrot and potato) in terms of moisture content, total soluble solids (TSS), vitamin C, acidity, surface color and textural properties like bioyield stress. Natural additives such as aloevera gel, citric acid and ascorbic acid were treated with fresh cut fruits and vegetables at refrigerated temperature. The fresh cut potatoes were treated with different concentration of citric acid and ascorbic acid and kept in freezer and refrigerator to analyze different physicochemical parameters for 15 days. In the fresh cut potato kept in the refrigerated condition, minimum weight loss was observed in 1.5% ascorbic acid treated sample whereas maximum weight loss was observed in 0.5% ascorbic acid treated sample. On the other hand, among the frozen samples, less weight loss was observed than refrigerated one and minimum weight loss was observed in 1.5% CA treated sample. In terms of pH, both the treated and untreated potatoes were seen to go upward with the storage time. For TSS, apart from control, maximum TSS was seen in 0.5% citric acid treated sample whereas minimum TSS change was for water in the refrigerated sample. For the samples in freezer, maximum TSS was 8.2^0 Brix in the sample which was treated with 0.5% CA and water. Titratable acidity was seen to decrease with time. In the refrigerated sample, least change was seen in water 1.5% Ascorbic acid sample whereas maximum ascorbic acid change was seen in 0.5% ascorbic acid sample. And for the frozen fresh cut potato samples, the change was seen less than the refrigerated sample. Ascorbic acid showed the similar trend like the titratable acidity. Among the treated refrigerated samples, samples with 0.5% citric acid had

the maximum ascorbic acid loss and the water treated sample had the minimum ascorbic acid loss. And for frozen samples, 1.5% citric acid treated sample held the minimum ascorbic acid loss. The color parameters (L*, a*, b*) showed increasing trend during storage indicating that the darkness, yellowness and redness increases with the time being. In terms of phenolic content, it was seen to increase with the time. Maximum phenolic content change was found in 0.5% ascorbic acid treated sample in both refrigerated and frozen fresh cut potato sample.

IoT and Computer Vision Enables Intelligent Crop Recommendation System Extracting Soil and Environmental Features

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Abstract

In today's automated aspects of agriculture, farmers must have up-to-date knowledge of crop selection, cultivation, and storage to ensure increased yields. Due to the limited area of domestic land, it is very important to select suitable crops based on the prevailing conditions in the selected area. Although some of the least developed countries have sufficient knowledge, techniques, and methods for manual cultivation, they do not have a system that can identify the important environmental factors for crop cultivation and advise the user. We implemented our proposed technique using MATLAB 20a, and we compared it with the most recent classification algorithms such as support vector machine (SVM) and K-nearest neighbors (KNN). If k=1 the object is assigned to its closest class. Photos of soil types were classified into five categories (i.e. black soil, cinder soil, peat soil, yellow soil, and laterite soil) using two techniques. Also, two criteria such as accuracy and confusion matrix are used to evaluate the performance of the system. The classification accuracy of the SVM model is 100% for cinder soil, laterite soil and peat soil, while it is 87.5% for black soil. Thus, the overall accuracy of the SVM model is 99.9%. In the confusion matrix of the K-nearest neighbor classifier, we observed that the classification accuracy of KNN for 81.8%. It is clear from the data collected by the sensors that this proposed system has 95% accuracy. Accuracy will increase significantly over time as significant amounts of data are collected and the system is self-trained in about a year. Tests conducted over 4-6 months proved the reliability and accuracy of the system. This system will surely be a torch bearer as the whole world is waiting for a new agricultural advisory system. Due to these problems, this crop recommendation system solution predicts to the user which crop type will be most suitable for the selected area by collecting environmental factors for plant growth and processing them with trained sub-models of the main sub-model of the system.

Development of Online Database for Medicinal Plants and Automatic Identification Using Machine Learning Based Android App

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Abstract

Medicinal plants are becoming increasingly popular due to their various remedial properties and less side effects. They play a major role for drug production in pharmaceutical industries. One-fourth of prescribed drugs are manufactured from the extracts of medicinal plants. They also work as antioxidants, anti-allergenic, anti-inflammatory, antibacterial and anti-hepatotoxic due to their several bioactive compounds such as phenolics, carotenoids, anthocyanins and tocopherols. But due to urbanization, most of the forests, trees and even small plants are eliminated to construct roads, buildings, and industries. Therefore, many valuable medicinal plants are becoming extinct from our planet. To save these plants, we have to be able to identify them. But most of us cannot classify the medicinal plants due to the lack of knowledge and expert opinions. Besides, it is difficult to manually classify a medicinal plant due to their various shapes and varieties. Therefore, an android app has been developed based on machine learning algorithm which is able to identify a medicinal plant automatically. To the best of our knowledge, there is no machine learning based medicinal plant classification app in Bangladesh. It can help to identify the valuable medicinal plants and save them from extinction. This project will thus greatly help to build a green planet by conserving and preserving the medicinal plants.

IoT and Deep Learning Based Smart System Development for Poultry Environment Monitoring and Controlling, Bird Growth and Sell Time Prediction of Poultry Farms

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Abstract
Poultry means the birds that can be domesticated for producing mainly meat and eggs. This section contributes 1% of country's GDP and around 60 lakhs people are involved in this industry. But, the production of birds depends on many factors including environment, timely food supply, and addressing immediate emergency situations. Environment is important because it affects the respiratory, digestive and behavioral patterns of the birds. Timely and adequate food supply are also important for the proper growth and at the same time for reducing food wastage. Addressing immediate emergency situations may include fire accident, disease outbreak, theft, sudden death of birds etc. So, handling all these factors are extremely important for ensuring the growth and profit of the farms. Currently, these factors are monitored and controlled by human labor force which is expensive and time consuming. So, it would be extremely beneficial if an automated system can be developed which can be deployed by the owners to monitor and control the environment and ensure proper growth rate without the need of any labor and at a cheaper cost. For this reason, we have built a complete smart system for poultry farms. In this system, we can collect image, video and other data using IP cameras, and sensors (e.g. temperature, light, humidity, oxygen, carbon dioxide, etc.). All these data are analyzed in the cloud server using deep learning and different predictions are made based on the data. An automated system is also developed using internet of things (IoT) which can regulate the ceiling fans, exhaust fans, and lights to control the temperature, light, oxygen level, carbon dioxide level, and humidity. All these modules can work together to address all of the above challenges.

Multiscale Contextual Information Determination of Protein-Protein Interaction using Parallel Filter based Deep Learning Algorithm

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Abstract
Many biological activities, including signal transduction, transport, and metabolism, depend on protein-protein interactions (PPIs). Proteins communicate with one another by creating chemical bonds. PPI binding sites are the amino acid residues that form the bond. Understanding cell regulatory systems, finding therapeutic targets, and predicting protein activities are all made possible by finding PPI-binding sites. To close the gap, numerous computational techniques have been created. Sequence-based, structure-based, and integrated computational approaches are the three groups into which they can be divided. The advantage of sequence-based approaches is that, compared to approaches focused on structure, they are typically quicker and less expensive. Therefore, in this project, we aim to find the PPI sites using sequence-based approaches. We have applied parallel filter based deep learning algorithm to find the PPI sites and extract multiscale contextual information. We have found better accuracy than the existing works. Therefore, our proposed algorithm can be used by the researchers to predict the protein-protein interactions successfully.

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Bacterial Genus Identification Using Machine Learning Algorithms

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Abstract

Bangladesh is mainly an agricultural country where most of the works are done using traditional human operated models. In bacterial genus identification field, the classification is also done using a time consuming and human based model. But in developed countries, a few bacterial genus classification works have been done using image processing techniques. In Bangladesh, it will be also very helpful for bacteriologists to identify the bacterial genus using image processing techniques. Students will be also benefitted by learning about the bacterial genus classification automatically. This autonomous classification system will make the classification cost-effective, fast, reliable and accurate. It has commercial benefits also for the pharmaceutical companies. Because the microbiologists, specially the bacteriologists, have traditionally identified Bacteria using cultural, morphological, staining characteristics, molecular techniques like Polymerase Chain Reaction (PCR) and phylogenetic molecular methods (i.e. sequencing the 16S rRNA gene). But in many cases, knowing the phylogenetic identity of Bacteria is not sufficient or necessary. Instead, being able to describe and track the morphological and visual characteristics of Bacterial cells and their resultant colonies and staining characteristics is the priority. Therefore, machine learning based image processing techniques is highly suitable to classify the bacterial genus efficiently and accurately. In this project, we have prepared an image data set of Bacterial Genera based on morphological features and processed the data set for feeding into different machine learning algorithms. Then we developed a model for the identification of Bacterial Genus using different machine learning algorithms. We have compared the results and found that our proposed method yields better results than the existing works. This will help many sectors in Bangladesh including veterinary research, genetics and bioinformatics fields.

CHAPTER VI
Faculty of Fisheries

Observation of Qualitative Phenotype in Inter-Strain Crosses of Nile Tilapia, *Oreochromis niloticus*: An Approach to Facilitate Students' Learning in Classical Mendelian Inheritance

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Abstract
The red strain of Nile Tilapia (*Oreochromis niloticus*) is highly sought after due to its contribution to food production, attractive skin colouration, and demand in the international market. In red tilapia culture, body colouration is one of the most important traits to increase their value and improve their acceptance. Understanding the mode of inheritance and gene action of the colour can play an important role in selective breeding programmes. The objectives of the present study were to determine the action of gene in the phenotypic expression of colour in inter-strain crosses of Nile tilapia, i.e., Wild and Red strains along with the identification of suitable DNA marker to screen specific morphotype and to compare the growth performance of the two strains (red vs wild). For the growth performance trial 50 red and 50 GIFT strain were reared for three months and growth data was collected weekly. To investigate the mode of gene action and impact of black blotches on body weight, 40 GIFT and 40 Red Nile tilapia were pool-bred with a 1:1 sex ratio. The phenotypes of randomly selected F_1 progeny were determined 8 weeks after their birth. The analysis revealed similar growth trends between Red Nile and GIFT strains, with no statistical differences in %WG (red= 35.14±6.85%; wild= 38.70±5.18%)) and SGR (red= 0.41±0.09%; wild= 0.34±0.05%) between the two strains (p>0.05). Complete dominant gene action was observed in the phenotypic expression of red colouration in the F_1 progeny. The Analysis of 50 F_1 specimens with ImageJ followed by manual curation revealed mean percentage of 2.87±0.34 of black blotches and a moderately negative correlation between black blotching and body weight. Also, Significant differences in the degree of blotching were found between male and female fish in this study (p<0.05). The analysis of DNA markers revealed polymorphism with UNH309 with the red and blotched phenotypes exhibiting a higher frequency of the "c" allele, while the "a" allele was prevalent in the GIFT strain. These findings might serve as the basis for the development of high growth performance red fish with blotched-free reddish skin in the future.

Development of Sustainable Mass Seed Production Technology for Golda Shrimp (*Macrobrachium rosenbergii*) and Production of Quality Broodstock in Captivity

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Abstract
Prawn hatcheries in Bangladesh have been encountering problems in PL production since 2012 and most of the private golda hatcheries have already been closed. Dependency on unpredictable wild sources for berried prawn (egg bearing mother) is another key constraint of golda hatchery industry in Bangladesh. For mass seed production, we operated the BRAC Prawn Hatchery in Barisal following standard protocol and produced some post-larvae (PL). The quantity of PL was not of satisfactory level because the rate of conversion to PL was very low and the mortality was high. The transformation of larvae to PL was delayed and finally a high mortality occurred. We have analyzed the berried prawn, larvae and hatchery water by microbiological and molecular methods and so far we have detected six bacteria. For broodstock development, we initially stocked PL in a nursery pond and then the juvenile/pre-adult were stocked in two ponds at two different stocking densities as a second phase to develop broodstock. We have produced some good quality berried prawn with an average weight of 71.40 g (ranges between 51 g to 129.4 g). The fecundity of the captive developed berried ranged from 14346-35044. We tested hatchability of the eggs of the berried developed in this project and observed above 90% hatching rates in aquarium which is a good sign and indicates that pond raised berried can be used in hatchery for PL production. We conducted an experiment to evaluate the effects of dietary administration of beta-glucan, a well-known immunostimulant. The prawns were fed a

formulated diet supplemented with commercial yeast β-glucan at 0.0%, 0.1%, 0.2%, and 0.3%. Two seven-day challenge tests with *V. parahaemolyticus* (first one with 10^6 cfu/ml and second one with 10^4 cfu/ml) was performed after the feeding trial. No significant differences ($p>0.05$) were observed in terms of final weight, specific growth rate (SGR) and weight gain (%) but, the prawns fed with 0.1% (T1) β-glucan (BG) had the highest survival rates (100%). However, immune parameter e.g. level of total hemolymph protein, albumin, globulin and total hemocyte count were found significantly higher ($p<0.05$) in prawns fed with 0.2% (T2) β-glucan supplemented diet. The findings of the study suggested that yeast β-glucan can be used at the dose of 0.1% to 0.2% to enhance the immune response of juvenile *M. rosenbergii* and increase their resistance to *V. parahemolyticus* infection.

Effects of Dietary Macroalga *Sargassum* Spp Extract on Growth, Feed Utilization, Hematological Indices and Non-Specific Immunity of Nile Tilapia, *Oreochromis Niloticus*

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Abstract

A study was carried out to assess the potential of *Sargassum* spp extract as a feed additive for Nile tilapia, *Oreochromis niloticus*. Four types of experimental feeds were prepared by mixing of 0, 0.5, 1.0, and 2.0% of hot water extract of *Sargassum* with commercially available Mega feed and considered as Feed-1 (control), Feed-2 (T-1), Feed-3 (T-2), and Feed-4 (T-3), respectively to investigate the growth performance, feed utilization, and non-specific immunity of *O. niloticus* challenged with *Aeromonas hydrophila*. Healthy mono-sex *O. niloticus* fingerlings with the average length of 4.42±0.34 cm and weight of 1.37±0.29 g were randomly stocked for 60 days in cisterns at a density of 20 $fishm^{-3}$ and fish was fed with the diets twice a day at 5% of body weight for two months. Sampling was done twice a month for examining the growth of fish. Liver, stomach and intestine of fish were collected for histomorphometric analysis. Results showed that average final body weight (24.27±1.40 g), percent weight gain (1773.77±320.7 %), specific growth rate (4.86±0.29) and survival rate (92.5±3.53%) in T-3 fish were significantly ($P<0.05$) higher than control and no significant ($P<0.05$) difference were found among T-1, T-2, and T-3. Food conversion ratio was found lowest in T-3 and highest in control. The HSI, RLG, and RBC count was also found significantly ($P<0.05$) higher in T-3 compared to control; whereas, highest glucose level was found in control fish. The clinical signs and post-mortem changes were also found less in the experimental fish fed seaweed supplemented feeds. The enhancement in growth rate, hematological parameters, less mortality against bacterial challenge test observed in the treated fish suggested that, *Sargassum* spp. could be supplemented to the *O. niloticus* diet at optimum level of 2% to improve immunity without any adverse effect on growth performance.

Modeling Climate Change Impact on Agriculture and Developing Mitigation and Adaptation Strategies for Sustaining Agricultural Production in Bangladesh

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Abstract

A study was conducted to explore the impact of climate change on tilapia (*Oreochromis niloticus*), pangasius (*Pangasias hypophthalmus*), and stinging catfish (*Heteropneustes fossilis*) in both traditional and controlled

husbandry systems with the aim of sustainable hatchery production in response to climate change. The study took place at the Asian Scientific Hatchery in Dhala Trishal Mymensingh, as well as fish in the earthen ponds near the faculty, and in the Laboratory of Climate Research for Fishes at BAU. Overall, the study assessed hatchery owners' perception of climate change through interviews, measured water quality parameters using relevant devices, estimated plankton abundance using the Stirling estimation technique, and evaluated growth, hematological characteristics, reproductive and breeding performance in relation to climatic factors using multivariate analysis. These aspects were compared with re-circulatory thermostatic systems. Future scenarios of significant climatic and biological parameters were understood through forecasting using the ARIMA modeling approach. Survey findings revealed that hatchery owners' can perceive about the influence of climatic factors in the hatchery activities as their context and practiced some traditional mitigation that are not found much effective. Climatic factors and water quality parameters were found to fluctuate during the study period, and a significant relationship was observed between climatic factors and water quality parameters. The highest water temperature recorded was 31.23°C in October for the tilapia pond, 35.93°C in May for the pangasius pond, and 33.3°C in June for the stinging catfish pond, while the lowest temperatures were 20.8°C in December for the tilapia pond, 31.45°C in November for the pangasius pond, and 17.6°C in December for the stinging catfish pond. These changes in water temperature affected other water quality parameters. Additionally, no harmful levels of ammonia were recorded in any of the species ponds during the study period. The abundance of phytoplankton and zooplankton in both tilapia and pangasius ponds varied during the study period, and the influence of climatic factors combined with water quality parameters was reported to contribute to this variation. The study found that the highest percent length gain (3.93%) occurred in February, with the lowest (0.88%) in January. Similarly, the highest percent weight gain (5.94%) was in April, contrasting with the lowest (0.68%) in December. The highest FCR (3.32) was noted in October, while the lowest (1.68) was in December. Regarding the specific growth rate (SGR) (%/day), the peak (0.29) was observed in October, and the lowest (0.021%) in December. Female fish during these periods had average body weights of 41.48 ± 2.83 g, 86.28 ± 1.51 g, and 68.34 ± 0.85 g, respectively. According to multivariate analysis (PCA), the growth, reproductive, and breeding parameters of the experimental fishes were found to be influenced by climatic and water quality parameters during the study period. Additionally, growth and breeding performance were observed to be higher in the control condition using the Re-circulatory Aquaculture System (RAS) approach, which produced comparatively higher quality than the traditional hatchery system. The ARIMA model forecasted an increasing trend in air temperature, water temperature, and gonad weight of male and female tilapia in the future. Specifically, the ARIMA model indicated that tilapia gonad weight increased with a certain level of water temperature rise and then declined when the water temperature increased excessively. The study concludes by proposing a dynamic model that expresses the future impact of climatic variables on stinging catfish growth and seed production performance within the hatchery system. Furthermore, the study aims to identify and develop possible mitigation strategies to ensure sustainable hatchery operations.

Molecular Analysis Underlying the Effect of Vitamin-e Supplemented Diet on Gonad Maturation of Indigenous Climbing Perch, *Anabas testudineus*

Prothoma Shaha Anu, Md. Golam Quader Khan, Abu Baker Siddique, Mohammad Mahfujul Haque[1] and A.K. Shakur Ahammad[*]

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Abstract

Anabas testudineus is a small indigenous species and valuable item of diet for sick and convalescent in Bangladesh. Regards, we collected wild sources of indigenous climbing perch populations and developing its in captive condition using Vitamin E supplemented diet under cage culture system. However, the objectives of this proposed research project were to detect the gonad maturity via histology and mRNA level of Dmrt1 and Foxl2 genes expression of *A. testudineus* using different concentration of Vitamin-E premixed diet and considered as six different treatments such as T_0 (0 mg/kg vitamin E), T_1 (50 mg/kg vitamin E), T_2 (100 mg/kg vitamin E), T_3 (150 mg/kg vitamin E), T_4 (200 mg/kg vitamin E) and T_5 (250 mg/kg vitamin E) for dose optimization. According to one-way ANOVA, present study revealed that T_2 (100mg/kg vitamin E) performed significantly better growth than other treatments (p value 0.001 which was $p<0.05$). For gonadal maturation of *A. testudineus*, T_2 (100 mg/kg vitamin E) showed highest number of vitellogenesis stage in compare to other treatments. Likely, qPCR primer for Dmrt1 and Foxl2 genes were perfectly matched and aneealed. Therefore, qPCR experiment revealed a relatively higher mRNA expression

for both Dmrt1 and Foxl2a genes in T_2 (100 mg/kg vitamin E) compared to the other treatments. This suggests an up-regulation of these genes in T_2, indicating that good quality and viable seeds can be produced through induced breeding. Based on this result it is clearly recommended that present research might be helpful for quality seed production by the hatchery operator, researcher and its conservation.

Reproductive and Breeding Performances of Indigenous Climbing Perch (*Anabas testudineus*) Broodstock with Vitamin e Premixed Dupplemented Diet

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Abstract

Reproduction and breeding performances of *Anabas testudineus* using vitamin-E supplemented diet is very crucial for quality seed production and its growth improvement for commercial aquaculture. The objectives was to determine the gonad maturity and breeding performance of *A. testudineus* using gonadosomatic index and induced breeding technique via pituitary gland extract, respectively. Adult *A. testudineus* were acquired from Shamgonj Beel, Netrokona district and back to Wet Laboratory, BAU, Mymensingh-2202. The fish were stocked and reared intensively in six cages considered as six different treatments (T_0-T_5) until gonadal maturation in the ponds. Subsequently, gonadosomatic index (GSI) and breeding performance was undertaken. The one-way ANOVA among the six different treatments revealed that T_2 (100mg/kg vitamin E) was performed significantly better broodfish growth than other treatments (p value 0.001 which was $p<0.05$). For gonadosomatic index (GSI), a one-way ANOVA among the treatments indicated that T_2 (100mg/kg vitamin E) exhibited significantly better performance than the other treatments (p-value = 0.001, which is less than 0.05). Further, GSI of *A. testudineus* was validated through performing the various trial of histology in gonad sample for maturity detection. Histology of the gonad sample in T_2 showed a higher level of gonad maturity in terms of vitellogenesis stages compared to the other treatments. Likely, treatment T_2 exhibited higher rates of fertilization (71%), hatching (65%), and survival (72%) at the 7 days after hatching, along with enhanced larval growth in comparison to other treatments. Also, T_2 demonstrated superior performance in embryonic development. In conclusion, the present study highlights the beneficial effects of vitamin E supplementation on the reproductive and breeding performance of *Anabas testudineus* in a cage culture system. These findings offer valuable insights for hatchery owners and aquaculture practitioners seeking to optimize seed production and foster the sustainable growth of indigenous fish species in captivity.

Chromosomal Analysis of *Tenualosa Ilisha* (Hamilton 1822), the National Fish of Bangladesh

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Abstract

The application of fish chromosomal analysis has received a considerable attention in recent years in many parts of the world, but there is still a very limited work on chromosome of endemic fish in Bangladesh. Various protocols have been established to accomplish distinct and identifiable metaphase chromosome spreads from gill of a single fish species. However, this protocol competency differs from species to species. The aim of the study was to improve the gill culture technique to achieve good quality chromosome spread and to estimate the number of chromosomes in Hilsha (*Tenualosa ilisha*). Metaphase chromosome spreads were prepared from the gill of juvenile fish. Live fish were injected intramuscularly with 0.05% colchicine solution at a dose of 1ml per 100 g body weight. The gill tissues were incubated with 0.56% hypotonic solution for 20 min and then fixed in carnoy's solution (methanol 3: acetic acid 1). For visualization of metaphase chromosomes, the slide was stained with 5 % Giemsa solution. Chromosome spreads were identified and the number of chromosomes was counted under 100X (oil immersion) magnification using a compound photographic microscope. Injection with 0.05% colchicine at a dose of 1 ml/100 g bw and 1 hour living period gave comparatively good metaphase chromosome spreads. The chromosome number obtained from the species was 2n=42 which is very similar to the family Clupeidae.

Isolation of Lactic Acid Bacteria from Three Indigenous Catfish Species for Potential Application as Probiotics in Aquaculture

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Abstract
LABs are regarded as the major group of probiotic bacteria found in the digestive tract of animals including fish. LABs like *Lactobacillus* sp., *Bacillus* sp., *Enterococcus* sp., and yeast, *Saccharomyces cerevisiae*, others including *Limosilactobacillus reuteri*, *Lactiplantibacillus plantarum* and *Fructilactobacillus fructivorans*, *Lactobacillus acidophilus* can be used as probiotics in fish culture. Therefore, the study was aimed to isolate and identify the probiotic strains of LAB from the intestines of three commercial freshwater catfish species (*O. pabda*, *H. fossilis,* and *M. cavasius*) in order to exploit them for further uses in aquaculture feeding. About 45 live fishes for each of the three species were collected from three different sources (two nearby fish farms and a local market) and conditioned for two days. The fishes were dissected and the intestines were homogenized in sterile 0.65% saline solution. The supernatant were removed and spread on Nutrient Agar as well as on Man, Rogosa and Sharpe (MRS) Agar plates. The plates were incubated at 37°C for 48 h. The colonies with clear zone were selected, and pure bacterial culture were maintained in 80% glycerol (v/v) at − 80°C for further analysis. Table 1 indicated the potential LABs detected through morphological and microscopic analysis. Genomic DNA was extracted from the selected bacterial isolates and the 16S rRNA gene region was amplified using the universal primer 27F (5′-AGA GTT TGA TCC TGG CTC AG-3′) and 1492R (5′-TAC GGT TAC CTT GTT ACG ACTT-3′). The Amplified 16S rRNA regions will be sequenced, and the similarity of the homolog sequences will be analysed using the Basic Local Alignment Search Tool program in the National Center for Biotechnology Information database for confirmation.

Production of Seeds of Indian Major Carps and Exotic Carps Using Cryopreserved Sperm in Public and Private Hatcheries and Assessment of Their Performance Through Growth Study and DNA Microsatellite Analysis

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Abstract
Indian Major Carps (Rohu, Catla, Mrigal) and Exotic Chinese Carps (Silver Carp, Bighead Carp, Grass Carp) are important aquaculture fish species and contribute significantly to the total fish production of Bangladesh. The aquaculture sector of the country is mostly (about 99.71%) reliant on hatchery-produced seeds. However, the quality of these seeds is declining due to genetic erosion. Therefore, this study aimed to establish cryogenic sperm bank of Rohu, Catla, Mrigal, Silver carp, Bighead carp and Grass carp from quality broodstocks to produce superior seeds using cryopreserved sperm in selected public and private hatcheries in four regions. Sperm was cryopreserved using Alsever's solution with 10% DMSO (% v/v) and stored in liquid nitrogen dewars as a cryogenic sperm bank. The 12 months storage effects on cryopreserved sperm revealed that post-thaw motility remained at a satisfactory level (>80%) for use in artificial breeding. During breeding at commercial hatcheries using cryopreserved sperm, the average fertilization and hatching rates were recorded 38.6±2.4% and 31.1±2.2 in Rohu, 38.1±3.2% and 31.0±3.1% in Catla, 38.1±2.1% and 30.4±1.9% in Mrigal, 41.3±4.3% and 30.9±4.0% in Silver carp, 43.0±1.8% and 33.0±1.3% in Bighead carp and 37.9±4.4% and 29.7±3.5% in Grass carp with cryopreserved sperm (treatment) respectively. Seeds of the six species were reared in the respective hatcheries and in few fish farms and sampled them regularly. After 180 days of rearing, higher growth rates were observed in cryopreserved sperm-originated fry than those originated from hatchery-owned fresh sperm due to introducing quality male germplasm from cryogenic sperm bank through artificial insemination. In addition, DNA microsatellite markers analysis demonstrated a consistent inheritance of superior alleles from the cryopreserved sperm donor parents to the fry following Mendelian rules. Finally, these findings highlight the need for establishment of fish germplasm repository to improve the quality of broods as well as seeds.

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Multi-Species Probiotics Ameliorate Salinity-Induced Growth Retardation in Striped Catfish *Pangasianodon hypophthalmus*

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Abstract
Salinity is regarded as one of the most crucial environmental parameters and salinity mediated stress adversely affect the aquaculture production. Probiotics might alleviate the salinity stress in fish. Here, we investigated the role of probiotics on growth (weight gain; WG, specific growth rate; SGR), survivability, feed utility (feed conversion ratio; FCR), hemoglobin (Hb), glucose (Glu), structure of erythrocytes (cellular and nuclear abnormalities), and gut morphology of striped catfish (*Pangasianodon hypophthalmus*) reared in different salinities. The fingerlings (8.10 ± 0.20 g) were evenly distributed four different salinities (0, 4, 8 and 12 ppt) in three replicates with and without probiotics supplementation for 56 days. Multi-species probiotics containing *Bacillus subtilis* (5×10^9 cfu/ml), *B. thuringiencis* (4×10^9 cfu/ml), *Lactobacillus plantarum* (5.8×10^9 cfu/ml), and *L. buchneri* (6.5×10^9 cfu/ml) were used as 1.0 mL/L at the alternate day. The results of this study indicated that survivability, growth and feed utility were negatively affected with the increased salinity, however multi-species probiotics significantly ameliorated the negative effects of salinity. Moreover, multi-species probiotics significantly improved Hb (g/dL) and Glu (mg/dL) level at different salinity in comparison with the non-probiotics treated groups. Frequencies of cellular and nuclear abnormalities of erythrocytes were increased significantly with the increase of salinity in non-probiotics groups, while those significantly declined in multi-species probiotics treated groups. Increased salinity level suppressed the immune response indices, while probiotics supplementation significantly improved the gut immune response irrespective of salinity level. Taken altogether, the current study revealed that application of multi-species probiotics can be an effective tool to reduce salinity stressors and improve growth and health status by upgrading hemato-biochemical profile and intestinal morphology of *P. hypophthalmus* at higher salinity.

Antibiotics in Aquaculture of Bangladesh: Abuse, Efficacy and Quantification

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Abstract
The present study was carried out to estimate the amount of antibiotics used in aquaculture activities in Mymensingh district. Data were collected from different pharmaceutical companies, drug retailers and fish farmers through questionnaire interview from July to December 2022. Seven groups of antibiotics having 25 different active ingredients with 82 trade names were found to provide by 12 different pharmaceutical companies. The groups of antibiotics included β-lactams, macrolides, sulfonamides, aminoglycosides, tetracycline, metronidazole, and fluoroquinolones. It was estimated that total 20.28 tons of solid and 23.96 tons of liquid antibiotics were sold during July 2021 to June 2022 for use in aquaculture with a total price of about Tk. 8.75 crore. Among the active ingredients of antibiotics, oxytetracycline in solid form has been sold at the highest amount of around 7.57 tons followed by erythromycin, doxycycline, amoxicillin, chlortetracycline, levofloxacin, neomycin, gentamicin, sulpha drugs, and ciprofloxacin. Of the total antibiotics sold during the mentioned year in year, 72% were used for terrestrial animal health and 28% were used for aquaculture. It was noticed that aqua farmers spent around 34% only for buying antibiotics and 66% for other medicines. Abuse of antibiotics were evident during the study. This study also assessed sensitivity of selected antibiotics against some emerging bacterial fish pathogens.

Effect of Papaya Seed Meal on Growth Performance and Hematological Responses of Nile Tilapia (*Oreochromis niloticus*) Fingerlings

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Abstract
The aquaculture industry is witnessing rapid growth, highlighting the need for natural feedadditives to replace antibiotics and harmful chemicals, promoting sustainable fish production. This study aimed to assess the impact of papaya seed powder (PSP) at varying doses on Niletilapia growth and hematological responses to identify the optimal dose for enhancing growth. Employing a completely randomized design (CRD), three treatments with three replications each were used: T1 (0.6% PSP), T2 (0.8% PSP), and T0 (control). Fish were fed anexperimental diet at 3.5% body weight twice daily for 60 days. Parameters assessed includedgrowth, nutrient utilization, survival rate, hematological parameters, and water quality. Results showed that T1 (0.6% PSP) exhibited superior outcomes in average weight gain(28.43±0.46 gm), percent weight gain (154.33±9.55), specific growth rate (0.68±0.03%), andfish production (4.27±0.07 kg/m³ over 60 days). T1 also had better feed conversion ratio(FCR) of 2.53±0.07 and protein efficiency ratio (PER) of 1.47±0.04 compared to T0 and T2. Hematological parameters increased with PSP dosage, with T2 showing higher hemoglobin(12.66±1.01 g/100ml) and glucose (103.6±20.51 mg/dl) content. Stress tolerance was highest in T1 (22±1.00 minutes). Water quality parameters remained within suitable ranges throughout the experiment. In conclusion, supplementation of 0.6% PSP significantlyenhanced growth and feed utilization in tilapia without adverse effects on survival, water quality, or hematological responses. This study underscores the potential of natural additives like PSP to support sustainable aquaculture growth, offering a promising alternative toconventional additives. Further research can explore the long-term effects and economicfeasibility of PSP supplementation in commercial aquaculture settings. Keywords: Aquaculture; Papaya seed powder; Tilapia; Growth performance; Sustainable feedadditives

Production Potential of African Giant Land Snail (*Achrachatina marginata*) in Captive Condition with and without Calcium Supplement

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Abstract
This 90-day experiment conducted at the "BAU Aquaponics Oasis" Laboratory in Bangladeshaimed to evaluate the influence of dietary calcium levels on the growth performanceof African giant land snails (AGLS) (Archachatina marginata) in captivity. The experiment, carried out from November 23, 2022, to February 23, 2023, employed three treatments (T0, T1, and T2) with three replications (R1, R2, R3) each. Treatment T0 served as the control with no calcium supplementation, while T1 and T2 contained 12% and 16%calcium, respectively. A total of nine 120-liter plastic tanks housed 15 snails per pen. Snails were fedaformulated feed with 23% protein at daily rates of 4%, 2%, 1.5%, and 1% of their bodyweight over the three-month period. Daily monitoring of temperature and humidity was conducted, with biweekly assessments of snail growth and production. Results indicatedthat treatment T2, with 16% calcium supplementation, yielded the highest mean weight gain, percent weight gain, average daily weight gain, specific growth rate, average daily feedintake, protein efficiency ratio (PER), survival rate, and overall snail production. Additionally, T2 exhibited the lowest feed conversion ratio, suggesting efficient feed utilization andenhanced growth performance.Conversely, treatment T0, lacking calcium supplementation, demonstrated the highest moisture, crude lipid, crude fiber, and carbohydrate content insnail meats, while T2 exhibited elevated levels of crude protein and ashcontents.Throughout the experiment, temperature and humidity varied among treatments, potentially influencing snail growth and development. In conclusion, the findings of this study suggest that AGLS exhibit improved growth performance and shell formation whenprovided with a diet supplemented with 16% calcium. These results contribute toour understanding of optimal dietary formulations for enhancing the productivity andsustainability of AGLS farming practices. Further research could explore the long-termeffects and economic viability of calcium supplementation in commercial AGLS productionsystems. Keywords: Archachatina marginata, Dietary calcium supplementation, Growth performance, Snail farming.

The Impact of Dietary Silver Nanoparticles (Ag-Nps) on the Growth, Survival and Feed Utilization of Pabda (*Ompok Pabda*)

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Abstract
A 56-day experiment was designed to evaluate the effect of dietary silver nanoparticles on the growth of Pabda (*Ompok pabda*) from June 24 to August 19, 2023, in the Wet Laboratory, Department of Aquaculture, Bangladesh Agricultural University. Silver, an extremely essential mineral and nutrient component here used in four treatments T_0, T_1, T_2 and T_3 having three replications with different levels viz. T_0: 0, T_1: 5, T_2: 10, T_3: 15 mg/kg. A commercial fish feed having 35% protein was used for the experiment. Twenty fish with a mean weight of 1.20 ± 0.02 g were assigned to in aquarium maintained in each treatment and fed with their respective diets in 12 aquaria. Feed was provided daily at a rate of 8% (fine powder feed) for 14 days during the early stage of development, followed by 7% for the next 14 days and 6% for the last 14 days and 5% for the final 14 days (pellet feed) of the body weight to rear fry. Pabda fry was fed twice a day (09:00 and 16:00), with sampling occurring at 14-day intervals. Throughout the study period, the effect of dietary silver nanoparticles on weight gain, percent weight gain, length gain, percent length gain, FCR, FCE, PER, survival rate, and water quality parameters were recorded. Water quality parameters were within the acceptable range during the study period. The highest mean weight, percent weight gain, mean SGR, mean FCE, PER, length, percent length gain was found 4.59 ± 0.39 g, 289.65 ± 28.3 %, 2.42 ± 0.12 %/day, 0.53 ± 0.04, 2.31 ± 0.12, 9.49 ± 0.23 and 178.71 ± 23.4 % in T_2 whereas lowest FCR (1.80 ± 0.15) was also found in T_2. The highest survival rate (88.33 ± 1.75 %.) was found in T_2. The present study revealed that growth parameters and feed efficiency increased significantly with the increasing level of dietary silver nanoparticles up to 10 mg/kg (Treatment 2) which could be incorporated in fish feed producing practices for increased fish production.

Role of Spirulina (*Spirulina platensis*) in Alleviating Arsenic Effects in Nile Tilapia (*Oreochromis niloticus*)

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Abstract
The present experiment was conducted to evaluate the effects of dietary spirulina (*Spirulina platensis*) in alleviating arsenic effects in tilapia (*Oreochromis niloticus*) for 60 days from 25th May to 23rd July 2023 in 15 experimental aquaria in the Wet Laboratory, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. The initial average weight of collected fingerlings was 0.65 ± 0.04 g. The fingerlings were reared in five different treatments (T_0, T_1, T_2, T_3 and T_4) having three replications in each treatment. Five experimental diets were prepared with supplementary spirulina and arsenic (T_0-20 g spirulina/kg feed; T_1, T_2, T_3 having 20 g spirulina and 5, 10, 15 mg arsenic per kg feed respectively; T_4-10 mg arsenic/kg feed). Feeds were supplied at the rate of 10% of the body weight for four weeks and 5% of the body weight for the rest of the experimental period. Fish were fed twice daily at 9.00 am and at 4.00 pm and sampling was done at 14 days interval. Water quality parameters were within the acceptable range during the study period. Results showed that growth parameters and feed efficiency increased significantly ($p< 0.05$) with the use of spirulina. This favor was gained because of the highest apparent protein digestibility with strong significance took place while fish were fed with spirulina. The hemoglobin level of the experimented fish was increased with the spirulina treatment. The heavy metal test result showed that the level of arsenic used in feed was decreased in the fish fed with spirulina. The present research findings suggested that the best growth performance, survival rate, digestibility and alleviating the toxic effect of arsenic of the experimental fish were obtained when fed with spirulina-supplemented diet. Therefore, for better growth and reduction of arsenic toxicity of tilapia the inclusion of feed in which spirulina could be introduced in manufacturing fish feed for tilapia.

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Designing Integrated Multi-Trophic Aquaculture (IMTA) with Different Extractive Species of Snails and Aquatic Plants

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Abstract
Bangladesh is blessed with a wide range of inland open waterbodies that include rivers, canals, floodplains, haors, beels, natural and man-made lakes, estuaries, brackish-water impoundments, and other inland waterbodies such as ponds, tanks, etc. Freshwater snails and aquatic plants, growing in various aquatic habitats, could be cultured to increase pond productivity with carp polyculture. Any plant, or portion of a plant, that grows either continuously or intermittently in water is considered an aquatic plant. Aquatic plants cultivated within the fishponds as part of an integrated system to an extent can enhance both water and soil quality. These plants can also serve as valuable components for compost fertilizer for agriculture use and provide nutritious food for both livestock and humans. The key objective of the research project was to design an Integrated Multi-Trophic Aquaculture (IMTA) system with different extractive species of snails and aquatic plants along with carps and small catfishes for increasing pond productivity. During the first year of the project, the primary focus of the research was to perform taxonomic identification and evaluate the diversity and abundance of potential aquatic plant and snail species across various pond systems, aimed at designing IMTA. For the assessment of snail and aquatic plant population, quadrat sampling technique was applied where a 1m² wooden quadrat was used. A total of 13 aquatic plant species and 6 species of snails and mussels were discovered during the study. The peak abundance of aquatic plants across different ponds occurred during July, August, September, and October, followed by a gradual decline in abundance during the subsequent months. The abundance patterns of aquatic snails closely mirrored those of aquatic plants.

Harnessing Machine Learning to Estimate Aquaculture Production and Value-Chain Performance in Bangladesh

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Abstract
Aquaculture plays a pivotal role in Bangladesh's economy, contributing significantly to food security, employment generation, and economic growth. However, lack of rigorous data collection means that conventional wisdom about aquaculture often lags far behind conditions on the ground and makes aquaculture production statistics unreliable. Inadequate information makes it difficult to plan and manage aquaculture development or design investments, policies, and interventions effectively. Moreover, new technologies and practices developed by innovative farmers and supply-chain actors often go unrecognized and may diffuse more gradually than they would if promoted actively by formal extension agents. Digital technologies are undergoing a revolution. Artificial intelligence (machine learning), remote sensing, smartphones, mobile internet, social media, and opensource data collection and video production software open up an array of new possibilities for cheaply collecting, analyzing, and communicating information in new forms to multiple audiences. Drawing together these strands, the research team of this project *"Harnessing Machine Learning to Estimate Aquaculture Production and Value-Chain Performance in Bangladesh"* (funded by USAID-FIL for Fish), combined survey-based research techniques with remote sensing, machine learning, and video production to generate knowledge products disseminated via digital media to reach farmers, enterprises, researchers, and government. Implementing this project in Bagerhat, Jashore, Khulna, Satkhira, Barishal, Bhola and Gopalganj district, the research team published 5 peer-reviewed journal articles, 2 success stories and 10 short extension videos. In terms of producing short extension videos, in-depth interviews were used to gather detailed information on aquaculture practices featuring individuals talking and demonstrating their innovative behavior in their own words to provide easily relatable content to be disseminated widely through social media platforms. Moreover, an interactive web-based statistical dataset, generated as a result of this project, has been delivered to the Department of Fisheries. They have integrated it into their website, making it readily accessible for stakeholders to utilize.

Abundance and Categorization of Microplastics Isolated from Farmed Fish and Fish Feed

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Abstract

As a new persistent environmental pollutant, microplastics have negative impact on aquatic environments and organisms and can also influence human health. Many studies have demonstrated the presence of microplastics in marine, lake, river systems or even in the aquaculture but very few studies have investigated microplastics in fish feed. Therefore, the goal of this study was to detect, categorize and determine the abundance of microplastics isolated from different fish feed samples of three different feed companies. Density separation method and KOH digestion method with sieving protocol were used to extract the microplastics from fish feed. In Density separation the highest recovery rate was reported. In this method a total of 1161 microplastics were identified whether in digestion method of KOH, a total of 972 microplastics were identified. Microplastic which have size less than 100 were abundant in both cases. Film type microplastic were found higher followed by fragments, granules and fiber. The findings of this study shed light on the issue of microplastic contamination in fish feed and the results presented here may be used as reference data for future studies on the potential environmental hazards of microplastics in the aquaculture of Bangladesh.

Towards Understanding Nematode Infestations in the Spotted Snakehead, *Channa punctatus*: Morphological and Molecular Approaches to Determine the Causal Agents

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Abstract

Parasitic nematodes infect fish species and fish- eating birds inhabiting freshwater ecosystems. The present study was conducted to identify the parasitic nematodes collected from the *C. punctatus* using morphological and molecular tools and to determine the seasonal variation of the parasitic infestation. Experimental *C. punctatus* were collected from different fish markets of Trishal, Mymensingh sadar, Netrokona and Jamalpur sadar. Our initial morphological and molecular analyses revealed that *C. punctatus* were heavily infested with *Eustrongylides* spp. Fourth stage larvae of *Eustrongylides* spp. were isolated from abdominal cavity, musculature and ovaries and identified by microscopic examination. The mean intensity of infection, prevalence and abundance were analyzed. Molecular characterization of collected parasites were done based on nuclear ribosoml transcribed spacer (ITS) rDNA regions and phylogenetic relationships of *Eustrongylides* sp. infestation in *C. punctatus* were established. The studied sequences were confirmed based on their percent of identity in NCBI BLAST search. The prevalence of *Eustrongylides* spp. was peak in autumn and lowest in winter. Higher prevalence was also observed in larger fish followed by smaller. Interestingly, prevalence and mean intensity was more in female as compared to male. NCBI BLAST search confirmed the identity of *Eustrongylides* sp., *E. exisus* and *E. ignotus*. In the phylogenetic trees, parasites were found to form clades according to their relatedness with each other. Clade 1 grouped with isolates of *E. ignotus* with strong nodal value (100%). Clade 2 consisted with two sister clusters. Sub-cluster one grouped with *Eustrongylides* sp. and *E. exisus.* Sub-cluster two showed monophyletic pattern with studied sequences and *Eustrongylides* sp. Close genetic similarity was revealed in studied sequences with *Eustrongylides* sp. The findings provide insights into the nematode infestation in *C. punctatus* and, may contribute to develop effective management strategies for the control of these infestation in fish populations.

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Impacts of Salinity on Growth Performance of Thai Pangas, *Pangasianodon hypophthalmus*

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Abstract
Salinity intrusion in the coastal areas due to climate change is alarming. The aim of the present research was to study the effects of salinity on growth, and physiological stress responses of Thai pangas. In the first experiment, the fingerlings were exposed to four salinities (0, 4, 8 and 12 PSU), each with three replications for 56 days. Salinity levels from 0 to 8 PSU showed optimal conditions with high survival rate and better growth performances in terms of weight gain and specific growth rate (SGR). The lowest food conversion ratio (FCR) was found in 4 PSU group. Second experiment was focused on hemato-biochemical parameters, structure of erythrocytes, and histopathology of gills, liver and kidney of the fish exposed to four salinities (0, 4, 8 and 12 PSU) for 56 days. The hemoglobin (Hb) level and number of red blood cells (RBCs) were found to be decreased significantly in 8 and 12 PSU compared to 0 and 4 PSU at the initial days of exposure, while number of white blood cells (WBCs) and glucose level showed opposite scenario. Frequencies of erythrocytic nuclear abnormalities (ENA) and erythrocytic cellular abnormalities (ECA) were significantly increased with increasing salinities in the initial days of exposure. Mild to moderate histological anomalies in gills, liver and kidney were detected in 8 PSU but pronounced alterations were detected at higher salinity (12 PSU) with increasing the days of exposure. Overall, the findings of the current study revealed that Thai pangas might be a suitable fish species for culture in the brackish water containing salinity up to 8 PSU.

Increased Ingestion and Toxicity of Polyamide Microplastics in Nile Tilapia with Increase of Salinity

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Abstract
Microplastics (MP) pollution and salinity intrusion in freshwater ecosystem is one of the worldwide climate change consequences those have negative impacts on the physiology of aquatic organisms. Hence, a 15-day experiment was carried out where Nile tilapia (*Oreochromis niloticus*) was exposed to different salinity gradients i.e. 0 ppt, 3 ppt, 6 ppt, 9 ppt, and 12 ppt alone and along with 10 mg/L polyamide microplastics (PA-MP) in order to measure its effects on the hematology, gill, and intestinal morphology. The results exhibited that all the fish treated with PA-MP ingested microplastics and the quantity of accumulation was significantly greater in higher salinity gradients (9 ppt and 12 ppt). In addition, the PA-MP treated fish showed increased glucose level and at the same time reduced hemoglobin concentration with the increase of salinity. The percentages of abnormalities in erythrocytes both cellular (twin, teardrop and spindle shaped) and nuclear (notched nuclei, nuclear bridge and karyopyknosis) significantly enhanced with PA-MP exposure again in higher salinity treatments (9 ppt and 12 ppt). The principal component analysis (PCA) exhibited that the addition of 10 mg/L PA-MP negatively affected the hematology of Nile tilapia than that of salinity treatments alone. Besides, the exposure of PA-MP in 9 ppt and 12 ppt salinity gradients escalated the severity of histological damages in gills and intestine. Overall, this experiment affirms that the increase of salinity enhanced the microplastics ingestion and toxicity in Nile tilapia, therefore, PA-MP possibly is addressed as additional physiological stressors along with increased salinity gradients in environment.

Study the Effects of Probiotics on Growth and Reproduction of Selected Farmed Fishes in Bangladesh

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Abstract
To know the effects of probiotics on gonadal maturation, expression of genes representing kisspeptin (kiss2), GnRH (gnrh1, gnrh2 and gnrh3) in the brain and GTH subunits (fshb and lhb) in the pituitary as well as gonadal histology and gonadosomatic index (GSI) were examined in Nile tilapia reared with probiotics. Male (n = 20/aquarium) and female (n = 20/aquarium) fry were reared separately with two probiotics (commercial and lab-developed) treatments, including a control (without probiotics), each with three replications for 6 weeks (42 days). The relative mRNA level of *kiss2* and *gnrh1*in the brain of both sexes significantly increased in response to probiotic treatment compared to the fish without probiotic. In the pituitary, the *fshb* in both sexes and *lhb* in females were also significantly increased in response to probiotic treatment. Histological analysis exhibited advanced development of gonad (higher proportion of spermatids and vitellogenic oocytes in male and female, respectively) with increased GSI due to probiotics application. Overall, the findings of this study suggest that probiotics have a stimulatory impact on gonadal development by up-regulating the kisspeptin/GnRH/GTH system in Nile tilapia. Locally developed putative probiotics showed better performance compared to commercial probiotics in terms of growth studies of rohu, tilapia, gulsha in aquarium and shing in biofloc, reproductive function in Nile tilapia.

Prevalence of Microplastics in Commonly Consumed Fish Species of the River Old Brahmaputra, Bangladesh

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Abstract
Microplastics (MPs) are pervasive in aquatic environments, but inland waterbodies (rivers and floodplains) have received much less attention. The present study assesses the incidence of MPs in the gastrointestinal tracts of five commercially important edible fish species – two column feeders (n=30) and three benthivores (n=45) from upstream, midstream, and downstream of the Old Brahmaputra river in north-central Bangladesh. MPs were detected in 58.93% of fish, with the highest level in freshwater eel, *Mastacembelus armatus* (10.31±0.75/fish). Fibers (49.03%) and pellets (28.02%) were the most frequent MPs. Nearly 72% MPs were smaller than 1 mm, and 50.97% were black. FTIR analysis showed 59% polyethelene (PE), followed by polyamide (40%) and unidentified (1%). MPs ingestion was linked to fish size and weight, and a high incidence was recorded in the downstream river. Two omnivorous benthic fish ingest more MPs than others. The results corroborate the presence of MPs in the inland river and fish fauna and augment our understanding of heterogeneous MPs uptake by fish.

Maturation Enhancement and Captive Breeding of Long Whiskers Catfish (*Mystus Gulio*)

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Abstract
This study focuses on the Long Whiskers Catfish (*Mystus gulio*), locally known as '*Nona Tengra*', a commercially significant estuarine catfish in Bangladesh with notable market demand as a food source. The primary objective

was to induce breeding and enhance fry production using a formulated feed with additives to improve captive maturation and subsequent fry survival. The Marine Fisheries and Wildlife Research Centre at Cox's Bazar Campus of CVASU served as the designated facility for rearing and breeding the catfish. During the experimental phase, brood fish were fed an artificial mix comprising spirulina (5g/Kg) and vitamin E-selenium (5mL/Kg), and gonadal maturation was meticulously observed in selected individuals during the breeding season (March-May). Gender differentiation of *M. gulio* was achieved based on genital papilla, size, coloration, and fin rays. Prior to the breeding trial, fish were maintained in a 1:2 (female: male) ratio, and critical water quality parameters were monitored (water temperature: 28-32°C, DO: 7.6-8ppm, pH: 7-8.2, salinity: 7.5ppt). Hormonal induction, specifically using Ovatide (GnRH) at precise doses (1 mL/kg BW for females and 0.5 mL/kg BW for males), was employed. Within a 72-hour timeframe, observation of larvae resulted in an approximate hatching rate of 60-62%. However, the adhesive nature of *M. gulio* eggs to substrates posed challenges in accurately determining the exact hatching rate. Commencing immediately after fertilization, embryonic development progressed, and fry rearing took place in the CVASU hatchery, incorporating various live feeds such as microalgae and rotifer along with conventional diets to optimize survival.

Population Parameters and Stock Assessment of Orangefin Ponyfish *Photopectoralis Bindus* in the Bay of Bengal

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Abstract
The research project assessed the population parameters of orangefin ponyfish, *Photopectoralis bindus* collected from the Bay of Bengal to be used as input values for estimation of the optimum yield with an ultimate objective to develop a sustainable fisheries management regime for the valuable species. Conventional models were used to estimate population parameters using data of 300 specimens collected from the artisanal fisheries based at Gangamotir char, Kolapara upazilla, Patuakhai district in Bangladesh. Standard length (SL) of sampled individuals ranged from 20 to 60 mm, and body weight (BW) ranged from 0.2 to 7.64 g over the the study period. Age was estimated decomposing the pooled SL data over the sampling months using Bhattacharya method into component normal distributions. Growth was best described by the von Bertalanffy model as $SL_t = 87.13$ [1- exp {-0.153 (t + 1.225)}], where t is in years for the species, based on χ^2 values over Gompertz and Robertson models. The study obtained growth performance 3.06, and approximate longevity was 19.63 years. The relationship between pooled SL and BW data was $BW = 0.0003SL^{2.44}$. The von Bertalanffy growth curve fitted with weight-at-age data was $BW_t = 14.2$ [1- exp {-0.183 (t +1.601)}]^3. Orangefin ponyfish recruited at 24.89 mm SL, and 0.98 years age to the adult stock. Length based catch curve and Pauly's (1980) equation yielded natural and fishing mortalities as 0.235 and 0.701 per year respectively, while the exploitation rate was 0.75 during the study year. The maximum yield per recruit was 0.91 g at fishing mortality of 0.3 per year, and the biomass analyses, however, estimated that *P. bindus* attained 1.9 kg relatively at the age of 4.9 years if 1000 individuals recruited to adult stock. Finally, the study suggested a format of sustainable management guide for the species incorporating the present findings.

Maximum Sustainable Yield and Fisheries Management of Savalai Hairtail *Lepturacanthus Savala* in the Bay of Bengal: Part II

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Abstract
Under the current part of the research, two population parameters namely growth and reproduction were studied. Monthly samples of savalai hairtail *Lepturacanthus savala* in the Bay of Bengal were collected for a period of one year from the artisanal fisheries based at Gangamotir char, Kolapara upazilla, Patuakhai district in Bangladesh. Bhattacharya procedure separated the pooled length frequency histogram of each of male, female and unsexed individuals into 5 age-groups. The study described the growth of three genders separately. Since statistics revealed

no difference between preanal lengths of male and female, and their growth curves (t-test and F-test; $p>0.05$), therefore, the present study adopted the estimates of unsexed gender as growth modelling of the species. The equations were as Bertalanffy model; $PAL_t = 35.53 \exp [-\exp \{-0.423 (t + 1.36)\}]$ for Gompertz model; and $PAL_t = 32.26 / [1 + \exp \{-0,671 (t - 1.95)\}]$ for Robertson model, where PAL and t are preanal length (cm) and t age (year). Growth was best described by the von Bertalanffy equation based on χ^2 values as goodness of fit index among three models. The relationship of pooled data of PAL and body weight (BW, g) was $BW = 0.0249PAL^{2.81}$, and the von Bertalanffy equation was fitted as $BW_t = 1086.28 [1- \exp \{-0.192 (t +0.63)\}]^3$ in terms of BW. Growth performance and approximate longevity were 2.62 and 10.79 years. Gonadosomatic index of male and female suggested that spawning season occured from January to March. Length and age of youngest spawning female were 20.2 cm SL and 1.14 years, while mean length and age at sexual maturity were 25.32 cm SL and 3.7 years. Calculated fecundity was from about 2986 to 31113 eggs in terms of PAL (12-33 cm), while it ranged from about 5207 to 48729 eggs with regard to BW (29-744 g).

How far are the Marine Hilsa Shad *Tenualosa ilisha* from the Spawning?

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Abstract

To appraise the reproductive state of the marine hilsa was one of the major objectives of the research project. Reproductive modes differ among species. Diadromous species undertake a long journey, often hundreds of kilometers to reach the spawning ground. The young of anadromous fish species migrate from the river to the sea for feeding, and at sexual maturation return to the river to spawn as adults. The Bay of Bengal is the adult stage region of hilsa shad *Tenualosa ilisha*, typically an anadromous species, from where it migrates to the major rivers e.g. the Meghna and Padma, and their tributaries for spawning. Gonadosomatic index (GSI) is a useful measure to reveal present reproductive condition of a fish individual. The study calculated mean GSI of the Bay of Bengal female hilsa among 12-month samples as 7.91% (range 0.04-16.42%). Though previous study revealed riverine hilsa started spawning at GSI 5.81%, but there is no report that hilsa spawn in marine water no matter having GSI 5.81% and even larger. Reproductive status of female gonads was compared among the Bay of Bengal, and two riverine i.e., Tentulia and Meghna rivers hilsa, based on relative gonadosomatic index (Gn) and relative condition factor (Kn), and gonad histology. Gn was calculated as (gonad weight/Ws) x100), where Ws is the length (L) specific standard body weight calculated as $Ws=aL^b$, and Kn was calculated as (body weight/Ws) x100, where Ws is the length specific standard body weight calculated as $Ws=aL^b$. Hematoxylene-eosine conventional technique was followed for ovary histology. Organ indices and condition factors though support partially not irrevocably that riverine hilsa were discernibly ahead of bay hilsa in reproduction (probability 0.05). Much more investigation into the concerned fact are needed viz., hormone profile measurement, and detection of the environmental clues that cause the onset of spawning.

Culture of the Green Alga, *Desmodesmus* sp. and its Use in Rearing Zooplankton and Fish Larvae

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Abstract

Microalgae have an important role in aquaculture being used as live food for the larvae of different fish and crustacean species, as well as zooplankton and all stages of bivalves. *Desmodesmus* sp. has remarkable prospects to exert benefits to aquaculture species by increasing their growth and survivability. The present research composed of three parts. In the first part, *Desmodesmus* sp. was cultured at different light intensities to see the optimum light intensity for best growth. The maximum growth rate was observed at 120 $\mu Em^{-2}sec^{-1}$. Highest chlorophyll-*a* content and the highest optical density were found at 120 $\mu Em^{-2}sec^{-1}$ on the 14^{th} day of culture. In the 2^{nd} part of the study, two consecutive experiments of zooplankton were carried out. In the first experiment of zooplankton, *Diaptomus*

and *Cyclops* were cultured at three different initial densities (T_1: 1×10^3 ind./L, T_2: 3×10^3 ind./L, and T_3: 6×10^3 ind./L) and fed a constant concentration of *Desmodesmus* sp. (1×10^5 cells/ml). The highest population density was obtained in T_3 ($28.33 \pm 1.69 \times 10^3$ ind./L) on the 5th day of culture. In the second experiment, the feeding response of copepods was studied at different level of live food concentration under three treatments where zooplanktons were fed live cells of *Desmodesmus* sp. (T_1: 1×10^5 cells/ml, T_2: 2×10^5 cells/ml, T_3: 3×10^5 cells/ml). The highest population density was found in T_3 where food concentration was also highest. In the 3rd part of the experiment, the rearing of 4th-day-old Indian major carp larvae, *Labeo rohita* was conducted with six different treatments using both *Desmodesmus* sp., and zooplankton as their feed: T_1 (live *Desmodesmus* sp.); T2 (live zooplankton); T_3 (powdered *Desmodesmus* sp.); T_4 (powdered zooplankton), T_5 (live *Desmodesmus* sp. + live zooplankton); and T_6 (powdered *Desmodesmus* sp. + powdered zooplankton). The *Labeo rohita* larvae fed with powdered zooplankton (T_4) outperformed all other treatments, with significantly higher ($p < 0.05$) larval length, larval weight, and specific growth rate, as well as survivability. The findings of the study explain the potentiality of *Desmodesmus* sp. in the rearing of zooplankton and larvae of major carps.

Mass Culture of Astaxanthin Producing Green Alga, *Monoraphidium Littorale* and Its Utilization in Aquaculture

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Abstract
Utilizing vegetable wastes to grow microalgae can successfully reduce the production costs by replacing expensive commercial media, and at the same time can help in environmental protection through waste remediation. As a way of starting an inevitable step-up, *Monoraphidium littorale* was grown in 25% (T_1), 50% (T_2), and 75% (T_3) of Digested Rotten Potato Supernatant (DRPS) for 16 days and at the same time in Bold Basal Medium (BBM) as a control (T_4). The highest cell density of *M. littorale* was recorded in T_1, followed by T_4, T_2 and T_3. In T_1, *M. littorale* biomass production was significantly higher ($P < 0.05$) than other treatments. The protein content achieved in T_1 at the end of the cultivation time was quite higher ($P < 0.05$) than in T_4. An in-door rearing study was also executed with *Oreochromis niloticus* larvae fed on live *Monoraphidium littorale* (T_1), live zooplankton (copepods) enriched with *M. littorale* (T_2), powdered *M. littorale* (T_3), powdered enriched zooplankton (T_4), live *M. littorale* + live enriched zooplankton (T_5), powdered *M. littorale* + powdered enriched zooplankton (T_6) to evaluate their effects on growth and survival. The *O. niloticus* larvae fed with the T_2 diet outperformed all other treatments, with significantly higher growth ($P < 0.05$) followed by T_5, T_6, T_4 and T_3 fed groups. Larvae fed with T_1 diet showed lower growth performance. Furthermore, the percent survival of the *O. niloticus* larvae was significantly higher in T_2, T_4 and T_6 groups followed by T_3 and T_5 groups. Larvae fed with T_1 diet showed significantly lower survival rate. The study elucidates the enormous potentiality of *M. littorale* and copepods enriched with *M. littorale* as the first external feed in the successful rearing of *O. niloticus* larvae. Based on the present findings, it is recommended that live copepods enriched with *M. littorale* can be utilized as a starter food for the rearing of Nile tilapia, *O. niloticus* larvae in hatcheries.

Effects of Different Physico-Chemical Factors on the Growth and Pigments of a Nutritious Microalga, *Scenedesmus* sp.

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Abstract
Scenedesmus sp. is regarded as one of the most important microalgae due to its higher biomass productivity, lipid, protein, and carbohydrate content and accumulation of pigments like chlorophyll, carotenoids, and lutein. Physicochemical factors not only affect the growth rate and biomass but also influence the composition of cellular metabolites such as lipids, proteins and pigments. The present study was aimed to investigate the effect of different physicochemical factors on the growth and pigments of the microalga, *Scenedesmus* sp. To assess the effects of

different factors, *Scenedesmus* sp. was cultured in Bold Basal Medium (BBM) at different light intensities (20, 80, 120, and 180 µmol m^{-2} s^{-1}), pH (6.0, 7.0, 8.0, 9.0, and 10.0), and different concentrations of nitrate-nitrogen and phosphate-phosphorus. The maximum growth performances (cell density, biomass productivity) and pigments (chlorophyll-*a*, chlorophyll-*b*, and carotenoids) were observed at a light intensity of 120 µmol m^{-2} s^{-1}, at neutral (pH-7.0) to alkaline (pH-8.0) conditions, at nitrate concentrations of 125 mg L^{-1} $NaNO_3$ and 500 mg L^{-1} $NaNO_3$, and at phosphate concentrations of 37.5 mg L^{-1} K_2HPO_4 and 87.5 mg L^{-1} KH_2PO_4 during the present study. The phycocyanine (PC), phycobiliproteins (PBP) and the allophycocyanine (APC), phycoerythrine (PE) were found maximum at the lowest (20 µmol m^{-2} s^{-1}) and highest (180 µmol m^{-2} s^{-1}) light intensity, respectively. The maximum APC, PE, and PBP were found in alkaline condition (pH-10.0), while PC was maximum in acidic condition (pH-6.0). In our study, the highest amounts of PC, APC, PE, and PBP were observed at a higher nitrate concentration (500 mg L^{-1} $NaNO_3$) and at lower phosphate concentrations (37.5 mg L^{-1} K_2HPO_4 and 87.5 mg L^{-1} KH_2PO_4). The present study concluded that, physicochemical factors can affect the growth and particularly the pigment contents of the microalga, *Scenedesmus* sp.

Stock Assessment and Management of Tengra Catfish *Mystus Tengara* in Bangladesh: Part III

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Abstract
The project attempted to estimate population parameters and maximum sustainable yield of *Mystus tengara* in the Dingaputa haor, Netrokona, Bangladesh with a view to suggest strategies for its sustainable management. In the previous two parts of the project, findings of size and growth parameter were reported. Gonadosomatic index of female concluded that the spawning season lasted from May to June. The minimum standard length (SL) and age at reproduction of female was 38 mm and 1.17 years, and the mean SL and age at first sexual maturity was 48.87 mm and 1.86 years respectively. The species is synchronous iteroperous that a female laid all eggs in a single spawning event. The calculated fecundity was from about 3199 to 6374 eggs in terms of SL (43-52 mm), while it ranged from about 3718 to 5967 eggs in terms of body weight (1.99-3.5 g). Since statistical tests provided evidence that there were no difference in SLs and growth equations between male and female (t-test and F-test; $p>0.05$), therefore, calculations of other parameters were done only for unsexed gender of the species. Recruitment occurred at SL 28.5 mm, and at age 0.75 years. The tengra catfish population suffered from the natural and fishing mortalities which were 1.17 and 2.43 per year. The longevity of the species was 3.95 years, and the fish were exploited at the rate of 67% during the study period. The maximum yield per recruit was 1.74 g at fishing mortality of 1.8 per year. The relative highest biomass of *M. tengara* was about 0.96 kg at the age of 1.32 years based on 1000 individuals recruited to the fishing ground in Dingaputa haor, Bangladesh. Incorporating relevant findings obtained in the research, a simple sustainable management protocol was prepared for the numerous stocks of the species across the country.

Investigation on Traditional Fermented Fish Products Throughout Bangladesh and Improvement of their Nutritional Quality and Shelf Life

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Abstract
Fish fermentation has long been a popular technology for the preservation of small cheaper fish in different parts of Bangladesh, especially in the North, Northwestern and Southeastern regions. There are many unknown fermented fish products available in rural Bangladesh, which have been serving important nutrition to the rural people, but their quality and nutritional status are completely unknown. Being the low quality could be serious public health concern, the traditional products with the existing processing methods, storage and marketing need to be investigated. The objectives of the projects were to conduct a country-wide survey to identify the traditional fermented fishery products of the country; to assess and evaluate the traditional processes of newly discovered and collected fermented

fish products; to investigate the nutritional quality and shelf-life of the traditional fermented products under different storage and packaging conditions in the laboratory; and to recommend best practices, along with improved packaging, for commercial manufacture of traditional fermented fish products. Field data were collected through face-face interview using semi-structured questionnaire, and also by check-list survey under holistic approach on traditional formulation, storage and marketing, constraints facing, solution measures taken, etc. in greater Mymensingh area, entire North Bengal, Brahmmanbaria, Sylhet-Moulvibazar-Shunamganj area, Chattagram, Khagrachari-Alikodom and Cox's Bazar regions. Survey data were cross-checked by key informant interviews with DoF field personnel. A total of 21 traditional products were identified, three of them were new records in Bangladesh. These were i. shidhal paste in bamboo hole from Borolekha of Moulvibazar; ii. shidhal pastes in plastic container from Bishanath of Sylhet; and iii. shidhal cake from greater Rangpur and Dinajpur areas. The samples were collected using appropriate method and stored in variable conditions in the laboratory for quality and shelf-life analysis, *viz*., proximate composition, per-oxide value, thioberbeturic acid reactive substance value, standard plate count, volatile base nitrogen, trimethyl amine nitrogen and sensory analysis. The source and state of raw materials, containers used for collection and fermentation, fermentation process, length and type of aging and storage period, packaging materials, marketing channels and operations, value-chain stakes, exporting countries and conditions, and price and profits of every 21 products were recorded and analyzed, in association with processors socio-economic profiles. Constraints in processing, storage and marketing were identified and solution options on for production, quality improvement, storage and marketing, as perceived by the processors and value chain actors were suggested. Market study revealed that there was no significant correlation between types of product sold with earnings of the shidhal producers and/or businessman ($p>0.05$). As far as the product types and processors are concerned, punti and phaisa shidhal producers earned more profit than others. Vacuum packaging was found to be a better option for adequate storage of these traditional products for good shelf life. For the first time in Bangladesh, several new products were identified and their processing technologies were known. Valuable traditional technologies and precious indigenous technical knowledge on the process were also known, which should be preserved and sustained generation after generation. Most of such traditional products were area-specific and some were found very vulnerable due to drastic reduction of consumers and price fall in the market. New generation consumers were found to be less interested on such traditional products. However, investigation showed huge potentials existed for such fishery products to keep up and link with Bangali culture and heritage.

Amino Acid and Fatty Acid Profiles of Semi-Fermented Fishery Products of Bangladesh

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Abstract

Semi-fermented fishery products, locally known as *shidal* or *chepa,* are rich in various nutrients and can provide notable health benefits. It has previously been documented that a variety of freshwater and marine fish species of Bangladesh, namely, spot-fin swamp barb (punti) *Puntius sophore,* anchovy (faissa) *Setipinna* spp., Indian pellona herring (marine chapila) *Pellona ditchela*, croaker (poa) *Johnius* spp., smooth-back herring (tedi fatra) *Raconda russeliana*, Indo-Pacific king mackerel (surma) *Scomberomarus guttatus*, bronze featherback (foli) *Notopterus notopterus*, and Gangetic leaffish (veda) *Nandus nandus* are being used to prepare *shidal*. The objective of this study was to determine and compare differences in crude protein, amino acids, lipid and fatty acids concentrations for *shidal* prepared from the above mentioned fish species to disclose the nutritional significance. The crude protein content ranged from 20.86±0.61% to 55.23±0.16% with the highest value in foli and the lowest value in surma. In case of amino acid profile, leucine was the most abundant among the essential amino acids (34.12±0.62mg/g in foli), and methionine being the least abundant (2.82±0.05 mg/g in faissa). Among the non-essential amino acids, glutamic acid (74.95±0.68 mg/g in foli) was the major whereas cysteine (0.001±0.001mg/g in poa) was the minor component. The percentage of essential to total amino acids which is regarded as indicator of protein quality was in the range of 36.3% (faissa) to 44.58% (surma). The lowest and highest lipid contents (2.86±0.61% and 5.4±0.29%) were recorded in foli and surma, respectively. The dominant saturated fatty acid was palmitic acid (46.90±5.69% in faissa) and the prominent monounsaturated fatty acid was oleic acid (33.74±8.48% in foli). The major polyunsaturated fatty acid primarily present as linoleic acid (7.08±3.88% in punti). *Shidal* prepared from the marine fish species showed higher n-3 (13.33% in poa) and n-3/n-6 ratio (6.43 in marine chapila) than the freshwater counterparts.

Quality Improvement of Traditional Dried Products Developed From Shol (*Channa striata*) and Gojar (*Channa marulius*)

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Abstract
To evaluate the performance and quality of the traditionally made sun-dried fish, the study was designed and conducted by producing experimentally sun-dried fish in an improved way for a comparative study. A survey was carried out along with several interview sessions at Kuliarchar Shutki Palli, Kishoreganj to acquaint with the general information relevant to dried fish production, drying activities, and marketing system to assess the present situation of the dried products, particularly in that area. Most of the dry fish processors were found unaware of the quality and safety of dried fish and have a negligible idea about packaging and storage facilities. In order to conduct the study two freshwater fish named shol (*C. striata*) and gojar (*C. marulius*) were selected for the experiment due to their higher nutritional value, popularity, and production as dried fish in the study area. The experiment was conducted for three months (90 days) under different packaging conditions to observe biochemical and microbial changes. The moisture content of raw shol and gojar was reduced in the improved dried condition, which was lower than the traditionally dried sample. The protein, lipid, and ash content were increased in improved dried fish from the raw conditions and comparatively higher than the traditional ones. The TVB-N content raised gradually with time, though it did not cross the acceptable limit except for the traditional samples in the non-sealed pack. The microbial load (APC) of dried fish decreased due to the drying process compared to the initial microbial load of fresh fish. However, the APC increased gradually during storage but was considered an acceptable quality. Results of the study indicated that if drying is appropriately done and dried products are kept in vacuum-sealed packets, they can be stored at room temperature for about 3 months without any significant deterioration in the quality.

Smoked Hilsha (*Tenualosa ilisha*): Assessment of Nutritional Quality and Shelf Life Study Under Various Storage Conditions

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Abstract
Preservation of hilsha (*Tenualosa ilisha*) by smoking is comparatively a new trend or new kind of study in Bangladesh. Development of smoked hilsha and study of its quality parameters has a great potential. Therefore, the present study was designed to investigate the shelf life and different quality aspects of smoked hilsa (Tenualosa ilisha) at room (28 to 32°C) and refrigeration (5 to 8°C) temperature. The study was conducted to evaluate the effect of spices and smoke source on nutritional quality of smoked hilsha (*Tenualosa ilisha)* stored at room (28 to 30^{0}C) and refrigeration (4 to 8^{0}C) temperature. In this study, five treatments T_0, T_1, T_2, T_3 and T_4 were used. Hilsa fish were treated with five different mixtures of spices (T_0, T_1, T_2, T_3 and $T_{4)}$ and then smoked at 70-80°C in an improved traditional smoking kiln. The products were packed in both sealed and vacuum sealed packets and stored at room (28-30^0) and refrigeration (4 to 8^0) temperature. It was observed that percent moisture content (%) decreased but protein, lipid and ash content smoked hilsha increased than those values obtained for raw fish. In quality parameters study, at room temperature (28°C to 30°C) and refrigeration (4 to 8^0) temperature, percent moisture contents increased throughout the storage period, but protein, lipid and ash contents decreased. The TVB-N, pH, peroxide value and standard plate count (SPC) of bacteria increased with the progress of storage time. Between two packets, products were in better condition in vacuum sealed packets than products stored in sealed packets. Among the five spices treatments T_1 {Onion (100g/kg) + Garlic (25g/kg) + Ginger (25g/kg) + Mustard seed (25g/kg) + Chili (25g/kg)} observed better to produce product of quality with longer shelf-life than those of T_0, T_2, T_3 and T_4. In section-2, to observe the effect of smoke source on smoked hilsha (*Tenualosa ilisha)*, the fish was first dipped in 25% brine solution before smoking. Smoked hilsha was then similarly packed in sealed and vacuum sealed packets and stored at room (28 to 30^0) and refrigeration (4 to 8^0) temperature. Here, moisture and ash content

increased whereas protein, and fat decreased considerably during storage. The TVB-N, pH, peroxide value and standard plate count (SPC) of bacteria increased with the progress of storage time but the rate of increment was comparatively slower in refrigeration temperature (4-8^0) and vacuum sealed packets than room temperature and sealed packets. On the basis of assessment of parameters, the overall quality of T_0 (Rice husk+ tamarind wood chips) product was better than T_1, T_2, T_3 and T_4 products. The study revealed that at room temperature the smoked hilsha cannot be stored for longer period, in fact not more than 12 hours in sealed packet and 15 hours in vacuum sealed packet. On the other hand at refrigeration temperature smoked fish may remain in good condition until 17, 27 and 40 days in non-sealed, sealed and vacuum sealed packets, respectively.

Development of Different Value-Added Products From Squid *(Loligo edulis*) of the Bay of Bengal and Quality Assessment of the Products Under Various Storage Conditions

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Abstract

The present experiment was conducted to develop different value-added products from squid (*Loligo edulis*) and to observe the shelf life of the products during storage at various conditions. Changes in sensory, proximate composition and TVB-N were determined for the developed products. Squid samples were collected from Cox's Bazar. Smoked squid, squid pickle and squid strips were prepared using different types of spices. Panel tests were done to determine the best combination of spices for the products. There were four groups of panelists including teachers, students, officers, and staffs. Fish spice mixed with marinated squid was best chosen by the panelists in case of smoked squid. Sweet and sour squid pickle were selected and in case of squid strips, Meat spices mixture with marinated squid was selected as the best sample. During the storage of smoked squid, moisture content (%) increased and protein content (%), lipid content (%) decreased. The TVB-N value of smoked squid increased in both room (28-30) and refrigeration temperature (4-8) though the increasing rate was slower at refrigeration temperature. In case of squid pickle, moisture content (%) and protein content (%) decreased both in room and refrigeration temperature storage. The moisture content and protein content of the squid strips decreased while squid strips were stored at frozen temperature (-18 to -20°C). Smoked squid was in good condition during refrigeration storage rather than room temperature. Humidity and temperature had effects on the shelf life of squid pickle stored at room temperature (28-30) but squid pickle was in good conditions up to 120 days at refrigeration temperature (4-8). Textural defects were observed in squid strips stored at frozen temperature within 56 days. Studies on quality assessment of squid products shows that squid products can be a great source of protein. Squid products can be introduced commercially which can be an income source for artisanal fishermen.

Studies on the Likeliness and Different Quality Parameters of ‘Tako Soup Powder’ and ‘Tako Ball’ Developed From Octopus

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Abstract

The present study was conducted to develop different value-added products from octopus (Octopus vulgaris) and to observe the shelf life of the products during storage at various conditions. Changes in sensory, proximate composition and TVB-N were determined for the developed products. Octopus samples were collected from Cox’s Bazar. Tako ball and tako soup powder were prepared using different types of spices and ingredients in the Laboratory of Fish Processing and Quality Control of Bangladesh Agricultural University. Panel tests were done to determine the best combination of ingredients for the products. There were four groups of panelists including teachers, students, officers, and staffs. As best composition, 70% mixed flour batter and 30% octopus mixture was

selected by the panelists for tako ball. On the other hand 2.5% tako soup powder and 97.5% soup premix was selected best composition for tako soup powder. During the storage of tako ball, moisture content (%) increased and protein content (%), lipid content (%) decreased. The TVB-N value of tako ball increased at both room (25- 30℃) and refrigeration temperature (4-8℃) though the increasing rate was slower at refrigeration temperature. In case of tako soup powder, moisture content (%)increased and protein content (%) decreased both at room and refrigeration temperature storage. Tako soup powder was in good condition during refrigeration storage rather than room temperature. Humidity and temperature had effects on the shelf life of Tako soup powder stored at room temperature (25-30℃) but was in good conditions up to 180 days at refrigeration temperature (4-8℃). Textural defects were observed in tako ball stored at room temperature within 7 days and within 13 days at refrigeration temperature. Studies on quality assessment of octopus products showed that octopus products can be a great source of protein. Octopus products can be introduced commercially which can be an income source for artisanal fishermen.

Evaluation of Proximate Composition and Sensory Properties of Spring Roll Pastry Prepared from Shrimp Offal

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Abstract
Fish and shrimp processing plants of Bangladesh produce huge amount of waste every year which contains considerable amount of nutrition. To utilize the discarded portions of shrimp processing industry and to get the nutritional benefit from them, this research was conducted to prepare spring roll pastry from shrimp offal (Head, shell, appendages, and antennae). Collected shrimp offal was dried, and pulverized to transform into powders. Three samples of prepare spring roll pastry were prepared incorporating 0% (C), 6% (T1), and 12% (T2) shrimp offal powder (SOP) with other ingredients. Organoleptic preferences, and compositional parameters of all the products were analysed. SOP has shown 9.62±0.27% moisture, 37.38±0.31% protein, 5.26±0.20% lipid, 28.80±0.27% ash, 16.87±0.24% carbohydrate, and 2.14±0.08% crude fiber. Protein, and lipid content of C, T1, and T2 were 5.82±0.16%, 27.65±0.36%; 10.78±0.17%, 22.73±0.26%; and 12.71±0.20%, 25.45±0.58%, respectively. Ash content was highest in T2 (3.77±0.19%), and lowest in C (2.20±0.19%). Maximum moisture (35.20±0.20%), and minimum carbohydrate content (25.85±0.42%) was found in C, whereas T2 presented the lowest moisture content (27.30±0.58%) among three samples. Inclusion of SOP contributed to the significantly increased amount of protein, carbohydrate, and ash content of the spring roll pastry. On the other hand, lipid and moisture content of SOP incorporated pastry were observed to be lower compared to control samples. Regarding sensory analysis, the overall acceptability score of C, T1, and T2 were 7.45±0.29, 7.87±0.26, and 7.44±0.31 indicating the preference for T1 compared to other two samples. In spite of increasing protein content with additional SOP, inclusion of more than 6% powder into spring roll minimised the taste, flavour, and overall acceptability of the products. Finally, 6% shrimp offal powder in fast food can be used to produce protein rich food products with excellent overall acceptability to meet the nutritional demand of human being.

Changes in Bacterial Community Structure During Live Fish Transportation

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Abstract
Bacteria present in the water during live fish transportation cause deteriorative changes (post-harvest loss), even death of the fishes. The community structure of bacteria is the sum of different species, important to understand the activities of bacteria to a particular environment. This study was conducted to determine the changes in bacterial community structure in water used during live transportation of different fish using the high-throughput sequencing approach. The correlation between the bacterial community structure with different physico-chemical parameters such as temperature, dissolved oxygen, ammonia, pH etc. was also assessed. Three supply channels of two selected fishes, Pangasius catfish, Pangas (*Pangasianodon hypophthalmus*), and Climbing perch, Koi (*Anabas testudineus*)

were considered. The supply channels were from Mymensingh to Dhaka, Faridpur, and Sylhet for Pangas; and from Mymensingh to Dhaka, Sylhet, and Rajshahi for Koi. Water samples were collected at 2 hours intervals during transportation and the water temperature, dissolved oxygen (DO), pH, and ammonia concentration were measured. For bacterial community structure, 200-500 ml of collected water was filtered using sterivex filter (0.22µm), DNA was extracted, polymerized targeting V4-V5 region of 16S rDNA, and sequenced using next generation sequencer, NGS (MiSeq, Illumina). The sequence data were analyzed using QIIME and other statistical tools. In case water quality parameters, ammonia and dissolved oxygen changed remarkably while temperature and pH remain almost stable in the transport water. Bacterial community structure changed with time, some groups become dominant gradually and some others outnumbered. In case of Pangasius catfish, Gammaproteobacteria, Flavobacteria and Firmicutes were the most dominant groups of bacteria. While in case of Climbing perch, Flavobacteria, Gammaproteobacteria, Betaproteobacteria and Firmicutes were the most dominant groups. Nonmetric multidimensional scaling showed that bacterial community structure of Pangasius catfish and Climbing perch were differently arranged indicating there were differences in the community structure of bacteria between studied fish species.

Screening and Molecular Detection of Potential Probiotic Bacteria from Gastrointestinal Tract of Freshwater Fish

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Abstract

Probiotics (live bacteria) improve organism's health and gastrointestinal function; enhance systemic immunity, digestibility and ultimately growth/ production. A number of commercially available imported probiotics (*Lactobacillus*) has been using commonly without considering their efficiencies and effectiveness on the native fish species. Thus, it is important to isolate and identify potential probiotics from the native freshwater fishes those can be used in their culture system. Considering the above fact, the study was conducted to screen, isolate and identifies potential probiotic bacteria (*Lactobacillus*) from the native freshwater catfishes such as- Shing *(Heteropneustes fossilis)*, Magur *(Clarias batrachus)* and Pabda *(Ompok pabda)*. The isolates were obtained through conventional culture based methods and identified through biochemical (pH and bile tolerance test) and molecular techniques. Samples were collected from three different areas such as- Kuliarchar Upazila (Kishoreganj), Jaria (Purbodhala, Netrokona) and Mohanganj Upazila (Netrokona) and analyzed in the Fisheries Microbiology Laboratory, Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh. A total of 60, 53, and 48 bacterial isolates were obtained from the intestinal microflora of *Heteropneustes fossilis*, *Clarias batrachus*, *Ompok pabda,* respectively and morphologically characterized. Colony morphology, pigments and surface areas were considered to select isolates and avoid similar isolates. Ten isolates from each fish species were selected for molecular identification and biochemical test based on their characteristics. Among the selected isolates, some of them were found potential and molecularly identified as potential probiotic bacteria. In future, the potential probiotics will be tested for their performances/ efficiencies in the aquaria and pond culture systems. In conclusion, it can be said that isolation and identification of potential probiotics from the native fishes will be the alternatives of the commercially available groups. These probiotics will provide better results in terms of their efficiencies, increase fish growth and control fish disease, which will ultimately enhance country's fish production.

16s Metagenomics in Tracking Microbiome Associated with Spoilage and Foodborne Pathogens in Shrimp Processing Industry to Ensure Food Safety

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Abstract

Microbiome of seafood processing plants offers crucial insights into resident microbiota and food manufacturing practices. This study utilized next-generation sequencing technology to assess bacterial diversity and identify

potential pathogens in processing plants to propose strategies to prevent their entry into the food chain. Twenty-four water and swab samples were collected from two fish processing plants located in Khulna Sadar, Khulna district, and Kuliarchar, Kishoregonj districts. Bacterial DNA was extracted and sequenced on Illumina NovaSeq 6000 sequencing targeting V3-V4 region of the highly conserved *16S* rRNA gene. Analysis of sequence data revealed significant bacterial contamination including potential pathogenic strains that were not possible to determine using conventional culture-based method. A total of 285,652 high quality reads obtained from swab samples, representing 31,135 operational taxonomic units (OTUs) with an average length of 423 bp using the SILVAngs pipeline. Swab samples exhibited a diverse array of bacterial phyla, with *Proteobacteria*, *Bacteroidota*, *Proteobacteria, Actinobacteriota, Patescibacteria*, *Firmicutes* being the most dominant. Using the 16SPIP pipeline, specific pathogenic bacteria were identified, included *Acinetobacter lwoffii*, *A. baumannii*, *Streptococcus parauberis*, *Staphylococcus aureus*, *Vibrio vulnificus*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, Pathogenic *Escherichia coli*. Soil and sand bacteria such as *Crossiella, Aridibacter*, were found at the receiving site, while enteric bacteria like *Bacteriovorax, Buttiauxella*, along with the opportunistic pathogen *Flavobacterium*, were detected at the shrimp grading table. The higher bacterial load observed in the samples suggests potential contamination during handling, inadequate hygienic practices, and contaminated water supply during receiving, deveining and grading processes. It is evident that environmentally-adapted microbes colonize equipment and tools surface in the processing plants. The findings highlight the need for improved hygiene practices and sanitation in processing plants to minimize cross-contamination and ensure food safety. Strengthening sanitation standard operating procedure (SSOP) and implementing corrective actions are essential to safeguard consumer health.

Antibiotic Resistance Profile and Molecular Characterization of Pathogenic Bacteria Emerging in Aquaculture Farms of Bangladesh

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Abstract

Antibiotic resistance poses a significant global threat impacting aquatic ecosystems and human health. Despite the ban on antibiotics, growth hormone and insecticides in fish feed banned in Bangladesh, fish farmers continue to use antibiotics to treat diseases. This study aimed to isolate and characterize pathogens emerging in major aquaculture areas of Bangladesh. Diseased fish samples of Nile tilapia and pangasius catfish from Mymensingh, diseased black tiger shrimp from Khulna and diseased Rohu fish from Rajshahi districts were collected and screened for specific bacterial pathogens. *Aeromonas*, *Streptococcus* and *Vibrio* spp. were isolated and characterized phenotypically and genotypically for their antibiotic resistance. Linkage between phenotypic and genotypic antibiotic resistance was also examined. Among the disease causing agents, *Streptococcus* spp. was the dominating pathogen in Nile tilapia and *Aeromonas* spp. in Pangasius catfish from Mymensingh district, as well as *Aeromonas* spp. in Rohu fish from Rajshahi district and *Vibrio* spp. in black tiger shrimp from Khulna district. They were identified up to species level using specific-specific primers. When their antibiotic resistance pattern was examined against the widely used antibiotics, it was revealed that pathogenic *Aeromonas* and *Streptococcus* strains showed highest occurrence of resistance to at least two antimicrobial agents, and they were regarded as multi-drug resistance (MDR) bacteria. This can be regarded as a consequence of poor farm management practices, lack of hygiene and bio-safety. These findings suggest that multidrug resistant *Streptococcus*, *Aeromonas* and *Vibrio* spp. are emerging as enteric pathogens in aquaculture, posing a threat not only to fish but also human health due to their zoonotic potential. Effective measures to control the spread of antibiotic resistance in aquaculture are urgently needed to mitigate this threat.

Combined Genotoxic Effect of Monocrotophos and Methomyl Exposures in an Air Breathing Catfish, *Heteropneustes fossilis*

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Abstract
An experiment was conducted to evaluate toxicities of two pesticides, Monocrotophos and Methomyl, singly and in mixtures, on the hematological parameters & organs of *Heteropneustes fossilis*. A static bioassay was conducted to determine the acute toxicity (LC_{50} value) of Monocrotophos (MC), Methomyl (MM) and their combination (MC+MM). The 96 h LC_{50} value of *H. fossilis* was 13.43 ppm for MC; 7.18 ppm for MM and 3.93 ppm for MC+MM respectively. The fish were exposed to 20% sub-lethal levels of LC_{50} value MC; MM and MC+MM at concentrations 2.69 ppm, 1.44 ppm and 0.79 ppm, respectively for 28 days to assess the effects of the pesticides on hematological status and organs of the fish. There was a significant decrease in combined exposure group in the blood glucose, hemoglobin content, hematocrit values and RBC compared to the single exposure following respective control. On the other hand, there was a significant increase in the WBC, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) values. The level of increasing WBC, MCV, MCH, and MHCH following the trend of Combined exposure> single exposure> control. The present investigation sufficiently emphasized that combined pesticide exposure had more adverse effects on the hematological parameters and organs of fish than a single pesticide exposure. Thus, the use of different pesticide in agriculture and aquaculture should be carefully evaluated.

Analyses of Species Diversity of Hard-Shelled Mollusks in the Kuakata Coast of Patuakhali: A Way of Sustainable Resource Management

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Abstract
Molluscs are the second largest phylum of animals, next to the arthropods. Today, many mollusks of commercial interest are at risk of extinction. However, controls are often lacking and very often many mollusks are still harvested indiscriminately. Identification of economically viable populations, i.e. standing crops of these mollusks around the coast of Bangladesh is an important first step. In the present study, seashell mollusk samples were collected from intertidal or subtidal habitats at locations across the southeastern coastal region of Bangladesh. All specimens were cleaned and immediately fixed with 75-90% ethanol, and transferred to the laboratory for further processing. They were observed closely by the necked eye and sorted into major faunal groups. A laboratory study was conducted in the wet laboratory and Marine Fisheries Science laboratory of the Faculty of Fisheries BAU, Mymensingh, Bangladesh. From our study, it was found that about 45 hard-shelled mollusks were identified from the coast. Among them, bivalve is the most commonest, and then the gastropods. *Codakia tigerina* species are available on the coast and it covers about 45% of all hard-shell mollusks. Some other common bivalves are *Fulvia laevigata, Atactodea striata*, *Donax faba*, *D. cuneatus*, *C. punctate*, etc. are important. Among the gastropods *Cypraea annalus, C. tigris, Olivia caerulea, Mitra mitra* etc. are important. Hence, the purpose of this study aimed to provide a status on the indiscriminate wild mollusk capture in the coastal zone of Bangladesh and their impact on the fisheries resources, and biodiversity, as well as to support environmental risk assessments of wild capture in aquatic ecosystems in relation to the management of coastal fisheries resources.

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Application of Symbiotic as an Environment-Friendly Approach on Growth and Immunity Development in Two Important Catfishes of Bangladesh

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Abstract

This study attempted to examine the effects of applying synbiotics at various levels (0%, 4%, 6%, and 8%) on the growth performances and the development of immunity of a commonly cultured Gulsha tengra (*Mystus cavasius*). With an average length of 4.39±0.03 cm and weights of 1.10±0.03 g fish were randomly placed in 12 plastic tanks, each with a 150L water capacity. Fish were supplemented with synbiotics (3.09×10^8 CFU/ml) at various levels (0%, 4%, 6%, and 8% and they were treated as T0, T1, T2, and T3, respectively) and fed twice daily at a rate of 3% body weight for a period of 45 days. Five fish were randomly chosen for sampling on every 0 (first counting day), 15, 30, and 45 sampling days of the experiment. Comparing all values the highest average villi length, villi width, and muscle cell, were observed at T3, significantly higher than control and other treatment groups. A higher concentration of synbiotics (8%) showed the best result and control showed the least growth performances and development of the immune system of fish. This study showed that varied concentrations of synbiotics can increase growth, and improve immunity. For successful grow-out culture and higher output, it appears that the researched synbiotic could be a useful dietary supplement and could be suggested to farmers raising silurid catfish, particularly *M. cavasius.*