

# BCSIR Congress 2019

*Theme: Science and Technology for  
Sustainable Development*

**12-14 December 2019**

## Venue

**Bangladesh Council of Scientific and Industrial Research (BCSIR)  
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205**

**Organized by**



**Bangladesh Journal of Scientific and Industrial Research (BJSIR)**



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## **BCSIR Congress 2019**

Day 1, 12 December 2019 (Thursday)

### **Plenary Session**

**Session Chair: Prof. Kavita Shah, IESD, BHU, India**  
**Venue: IFRD Auditorium**

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## **Bamboo as an Emerging Fiber sources for Pulping and Papermaking**

**Y. Ni<sup>1\*</sup>, Z. He<sup>1</sup>, C. Duan<sup>2</sup> and Y. Xu<sup>2</sup>**

<sup>1</sup>*Department of Chemical Engineering, University of New Brunswick, Fredericton, NB E3B 5A3, Canada*

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### **Abstract**

Bamboo forest is widely distributed in subtropical and tropical areas, and Asian countries are rich in bamboo resources. To mitigate the shortage of wood resources, bamboo has emerged as an important raw material for pulping and papermaking, particularly in China. In this presentation, bamboo fiber morphologies/ characteristics, and the present utilizations of bamboo, particularly for pulping/ papermaking in China, will be discussed. New technologies, such as silicon removal to overcome the disadvantage of bamboo as a pulping raw material, as well as those to improve the quality of bamboo pulp products, will be highlighted. A case study will also be presented on using bamboo as fiber sources to produce tissue paper (both bleached and unbleached), which has gained significant market recognition in the fast-growing Chinese tissue sector. It is expected that the bamboo pulping capacity in China continues to increase in the near future.

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## **Industrial chemicals and environmental health - With a focus on endocrine disrupting chemicals**

**K. Choi**

*Seoul National University, Seoul, Republic of Korea*

### **Abstract**

In modern society, humans rely heavily on chemicals for health, well-being, and numerous other benefits. Worldwide, the production of chemical has increased by 300 times during last 50 years. While chemicals are intentionally developed and used for specific benefits, their side effects have also been identified as well. Most adverse outcomes to due chemical exposure are neither acute nor lethal, and difficult to be recognized. However, these adverse outcomes could cause serious societal and public health burden on humans. It is therefore one of greatest challenges of our society to identify hazardous chemicals and to help people and industries choose and use safer alternatives.

It is often extremely difficult to understand the link between chemical use and diseases. That is because we are exposed to a myriad of chemicals often at very low doses for long time. Endocrine disrupting chemicals (EDCs) are among the chemicals we are exposed to everyday. EDCs are chemicals that can interfere with normal endocrine function and cause adverse effects on individuals, their progenies, or even populations. These chemicals are suspected to be linked with numerous 'modern' diseases which include cardiovascular diseases, metabolic syndromes, male and female reproductive disorders, thyroid diseases and others. In this talk, I will introduce what EDCs are, and how EDCs jeopardize humans and ecosystem. Then, I would like to share possible approaches to address such challenges.

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**Technical Session-1A : Pulping and Bleaching-1**

**Session Chair: Prof. Dr. Haseena Khan, DU  
Venue: ITTI, Room no. 611**

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## **Approaches to enhance enzymatic saccharification of lignocellulosic biomasses by water-soluble lignin addition**

**W. Wang, Y. Zhu, C. Jiang, Y. Wang, Y. Jin\***

*Jiangsu Co-Innovation Center of Efficient Processing and Utilization of Forest Resources, Nanjing Forestry University, Nanjing 210037, China*

### **Abstract**

The influence of lignin on the enzymatic digestibility of lignocellulose has been widely investigated. Physical blockage and unproductive enzyme binding were recognized as two mechanisms that inhibit the enzymatic digestibility. Hydrophobic interaction between cellulase and lignin has been considered as the primary driving force that governs cellulase non-productive binding. Certain additives such as PEG can increase the substrate enzymatic digestibility (SED), while kraft lignin (KL) exhibits little or even negative effect. The cellulases are easy to be adsorbed non-productively onto KL due to its insolubility in water, which results in a low enzymatic sugar conversion. In this work, water-soluble lignin samples, including sulfonated lignin (SL) and kraft lignin fraction which can be dissolved in water at pH 5 (KLWS), was used as additives in the enzymatic hydrolysis to understand their effect on the enzymatic saccharification of green liquor (GL) and acidic bisulfite (AS) pretreated poplar. The results showed that the addition of water-soluble lignin could considerably increase the enzymatic sugar conversion. The SED increments of both GL- and AS-pretreated poplar were more than 25 percentage points when KLWS and SL was charged at 0.1 g and 0.2 g per gram of o.d. substrate, respectively. Excessive addition of SL or KLWS resulted in a drop of the SED. The existence of water-soluble lignin reduces the non-productive adsorption of cellulases onto the substrate lignin, which can be explained by “competitive adsorption mechanism”.

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## **Anatomical study of *Gmelina arborea* for its pulp and paper potential in Indian subcontinent**

**R. Rana\* and S. Gupta**

*Wood Science and Technology, Forest Research Institute, Dehradun, India*

### **Abstract**

*Gmelina arborea* is a well-established plantation species throughout the world and its natural geographical distribution. The fast-growing nature makes it a suitable species for the growing needs of structural timber as well as composites. Wood anatomy holds the key for predicting pulping properties of potential species. The present study assessed 21 wood samples of *G. arborea* collected from 18 localities in Indian Subcontinent. Samples were macerated using Schultz's method for determining different fibre dimensions. The study acknowledges that mean fibre length of  $1339.24 \pm 103.89 \mu\text{m}$  and fibre diameter of  $27.01 \pm 2.47 \mu\text{m}$  makes it excellent hardwood for pulping. Furthermore, the assessment of six fibre derived ratios pointed towards its highly promising prospects in pulping industry. The relative comparison with other prominent species like eucalyptus and poplars makes a good case for its wide scale adoption in pulping industry. Cell type analysis reflects the basic constraints in its utilization with low fibre content in respect to other species which ultimately can have effect on its economic viability as pulping species. Significant differences were observed among different samples from different regions. Such differences within a species reflects inherent diversity in form of genetic and physiological aspects. The present study suggests that these variations can be harnessed in breeding hybrids with desirable pulping properties.

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## Displacement washing of kraft spruce pulp

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<sup>1</sup>*Pulp and Paper Research Division, BCSIR Laboratories Dhaka, Bangladesh Council of Scientific and Industrial Research*

<sup>2</sup>*Institute of Chemistry and Technology of Macromolecular Materials, University of Pardubice, 532 10 Pardubice, Czech Republic*

### Abstract

Displacement washing is the most effective mechanism of brown stock pulp washing. The objective of this work to investigate the influence of the degree of delignification of kraft spruce pulp cooked on seven different kappa numbers in the range from 18.1 to 50.1 upon the efficiency of displacement washing. Using the step function input change method, the washing breakthrough curves measured for alkali lignin as a tracer was described by the dispersed plug flow model. Besides the traditional wash yield, the relationships between the axial dispersion coefficient and Reynolds number as well as between the mean residence time and space time were investigated. The results obtained showed that both the washing yield and the bed efficiency increased with increasing the Péclet and kappa numbers. Efficient washing also reduced the kappa number and the residual lignin content in the pulp fibres that would positively affect the bleaching operation.

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## Influence of age on chemical pulping of gamar (*Gmelina arborea*) wood species

D. Biswas\*, M. Misbahuddin, N. Khatun and U. Roy

*Bangladesh Forest Research Institute, P.O.Box 273, Chattagram-4000, Bangladesh*

### Abstract

Utilization of short rotation species for pulp production is one of the approaches to meet the demand of pulpwood in the industry. In this study pulp making characteristics of gamar wood (*Gmelina arborea*) of five age groups have been studied with respect to yield and quality pulp to reduce the harvesting time of the species. Pulps were made from 4, 6, 8, 10 and 12 years gamar chips in kraft process maintaining 25% sulphidity by varying alkali doses (16, 18, & 20%). The temperature was maintained at 170°C during pulping. Yield and Kappa numbers were determined. Alkali requirement tended to decrease with tree age. At 20% active alkali bleachable grade kraft pulp was obtained from 8 years old tree with pulp yield 52.3%. The yield of gamar was comparable to other hardwood species widely used in pulp and paper mills of Bangladesh.

The hand sheets were made and the physical strength properties likely tear, tensile and burst were evaluated at two freeness level. The strength properties of 4 and 6 years gamar pulp showed low tear strength. With the increase of age tear strength increased. The pulps produced from 8 years and onward possessed moderate strength properties. Considering pulp yield and quality, the optimum cutting cycle of the species would be 8 years. The pulp from 8 years old species could be used for producing moderate quality writing, printing and wrapping papers. Future research on response of bleaching chemicals to the pulp is needed.

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## **Pulp and Paper Sector in Bangladesh-Challenges and Solution**

**M. M. A. Quader**

### **Abstract**

*BCIC (KPML/TICI), Chattagram, Bangladesh*

An over view of pulp and paper industries in Bangladesh have been presented. This paper has forecasted on the Pulp and Paper demand and demand growth in Bangladesh as well as in the world. Detail investigation has been carried out on the areas (both hilly land and coastal areas) from where the fibrous raw materials can be produced and collected for paper industries. KPML, only one 70 years old integrated pulp and paper industriy in Bangladesh still running but under design capacity. KPM/BCIC intended to establish a bigger integrated pulp and paper industry having capacity of 1 lac to 2 lac MT Paper per year to meet a portion of the growing demand of the same. Also, KPML/BCIC locking for investors having experience both on paper industry and forestry to make a partnership under PPP format to establish the new mill and details will be presented in the paper.

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**Technical Session-1B: Biopolymer**

**Session Chair: Dr. Chao Tian, CNPPRO, China**  
**Venue: IFRD Auditorium**

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## Natural rubber-lignin composite for bitumen modification

S. K. Ray\*, R. H. Bhuiyan, M. S. Islam, M. J. Abedin, Z. Islam, M. R. Hasan, L. N. Hilary and H. P. Nur

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### Abstract

Modified bitumen (MB) is getting more attention in paving application due to higher durability and quality of heavy traffic roads in comparison to unmodified bitumen. Some earlier works on bitumen modification showed that different additives or mixture of additives can significantly improve the performance of unmodified bitumen. In this study, a novel bitumen modification process has been developed using natural rubber-ribbed smoked sheet (NR-RSS) and soda lignin (SL) isolated from waste green coconut fibre. At first, natural rubber along with some additives was mixed in a solvent and then soda lignin was added. The mixture was characterized by rotational rheometer applying different temperature and shear rate and then cured at 135°C for 30 minutes. Fourier transform infrared spectrometer, Universal testing machine and Simultaneous thermal analyzer were used to examine the properties of cured mixture. In the modification process, the uncured mixture was blended with 60-70 penetration grade bitumen (B) applying suitable condition. Physical, spectral, microscopic and thermal properties of modified bitumen (MB) were evaluated and compared with unmodified bitumen. It was shown that the prepared natural rubber-lignin composite can significantly improve the physical properties of 60-70 penetration grade bitumen as required for flexible pavement construction in tropical countries. Marshal stability was improved by 25% in comparison to 60-70 penetration grade bitumen. All findings have been discussed in details.

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## Preparation and characterization of glycerol-plasticized PVA-chitosan blend film

M. S. Islam<sup>1\*</sup>, B. K. Ray<sup>2</sup>, Z. Islam<sup>1</sup>, M. R. Hasan<sup>1</sup>, M. J. Abedin<sup>1</sup>, M. M. Rahman<sup>1</sup>, S. K. Ray<sup>1</sup>, S. Sultana<sup>1</sup>,  
and W. M. Ajmotgir<sup>2</sup>

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### Abstract

In this work glycerol-plasticized blend-film based-on chitosan and polyvinyl alcohol (PVA) have been prepared for possible use in the controlled release applications. PVA-chitosan blend films in the ratios of 5:1, 2:1, 1:1 (w/w) have been prepared by solution-casting method. Glycerine percentages in the plasticized films were 1%, 2.5%, 5%, and 10% by weight. Curing time of the films was about 120 hrs and it increased with the increases of glycerol ratios up to 168 hrs. Molecular structural changes in the blended films have been evaluated by FT-IR spectroscopy. Tensile strength of the prepared films increased with the increase of chitosan ratios and elongation at break increased with the increase of glycerol. The water uptake capacity of the prepared PVA-chitosan film varied from 142%(w/w) to 794%(w/w) of initial films weight and decreased with the increase of chitosan content. Soil burial degradation test results shows that all of the prepared films degraded within 6 to 8 weeks. The experimental results of the pH-responsive degradation show faster swelling and degradation of unplasticized films than that of plasticized films. In case of plasticized films, slower swelling and lower degradation was observed with the increases of glycerol content. Therefore, higher quantity of glycerol-plasticization will be required for slow release applications. From the results of this experiment, it can be proposed that the glycerol plasticized PVA-chitosan blend films can be opt for controlled release of drugs, especially the gastrological drugs because of its pH-responsive behaviour.

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## Synthesis and Characterization of Temperature/pH dual sensitive hemicellulose-based Hydrogels from eucalyptus APMP waste liquor

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<sup>4</sup>Biological Systems Engineering, University of Wisconsin-Madison, Madison, WI 53706, USA

### Abstract

With the advantages of woody hemicellulose structure, the extraction, modification and utilization of hemicellulose in waste liquid is a method to improve the economic output value of pulp and paper industry, hemicellulose hydrogels are a good material in chemical and medicinal industries and so on. In this article, hemicellulose from eucalyptus APMP waste liquor was used as raw material, adding acrylamide (AM) and acrylic acid (AA) monomers, N, N-methylene bis acrylamide (MBA) as cross-linking agent, hemicellulose-based hydrogels with temperature- and pH- sensitive was prepared in a one-pot method. The results of Fourier transform infrared spectroscopy (FT-IR) showed that the hydrogels were successfully prepared; and scanning electron microscopy (SEM) showed that the hemicellulose-based hydrogels had a regular pore structure; the swelling degree of hydrogels at different temperatures and pH values was measured. It has been proven that hemicellulose-based hydrogels have temperature/pH dual sensitivity according to illustrate the reaction mechanisms of hydrogels swelling phenomenon.

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## Cotton fabric modified with silk sericin and chitosan to improve textile performance for medical applications

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*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### Abstract

Chitosan and silk sericin were applied on cotton fabric by pad-dry-cure method to improve the functional properties of cotton fabric in presence of citric acid as crosslinking agent. Silk sericin powder was extracted from boiled water solution of silk cocoons through ethanol precipitation and chitosan was extracted from shrimp shell through several steps. Extracted sericin powder and chitosan were characterized by UV spectrophotometer, Fourier transform infrared (FTIR), XRD and TGA. Antimicrobial activity, antioxidant property, solubility, moisture content and molecular weight were also analyzed. Silk sericin treated samples showed improved UV protection factor compared to chitosan treated samples. The antimicrobial activity of sericin treated cotton was poorer than chitosan treated specimen. The antioxidant property of sericin treated cotton fabric has showed excellent performance. Both chitosan and silk sericin enhanced moisture regain and absorbency. Thermal comfort properties like water vapour permeability, air permeability and thermal conductivity were analyzed. Combined treated cotton fabric



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illustrated better functional properties compare to single treatment at the same concentration. Physical properties, such as stiffness, crease recovery, abrasion resistance, whiteness index and thickness were also determined. The presence of chitosan and sericin in the treated fabric was confirmed by FTIR, SEM study and XRD. Results suggested that sericin and chitosan might be a valuable ingredient for the development of protective textiles especially for medical sector.

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## **Preparation and characterization of cellulose-based biodegradable hydrogel from CMC for personal care product**

**M. O. Haque, M. I. H. Mondal\* and M. A. Sayeed**

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

Synthesis of natural polymer based biodegradable hydrogels is a current research interest to scientists. Derivatization of cellulose alters its properties profoundly, which showed path to the scientists to apply the cellulose derivative in many attractive applications. An eco-friendly Super- Absorbent Hydrogel (SAH) was synthesized by graft co-polymerization using most generously produced cellulose derivative carboxymethyl cellulose (CMC), methyl methacrylate (MMA) and acrylamide (AM). Prepared hydrogel sample showed good swelling as well as short span of time for reaching equilibrium water absorption capacity. For the best performance, the synthesized product reaction dependent parameters were optimized. Besides analysis through physical methods the samples were also characterized by modern instruments (FTIR, XRD, SEM, and TGA). In addition to personal care product, the product was also applied in heavy metal and dye adsorption to bring diversification in application. Our synthesized product showed swelling capacity of 440 g/g, 2.5h of equilibrium water absorption capacity and about 53% degradation of prepared sample within 90 days of observation period. From the above discussion, it is clear that the synthesized superabsorbent hydrogel [CMC-g-(MMA-co-Am) hydrogel] can be applied in health care sectors to create products more environment friendly compared to available petroleum based product and apply in water purification as filter aid.

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**Technical Session-1C: Glass, Ceramics and Biomaterials**

**Session Chair: Dr. A. K. M Abdul Hakim, BUET  
Venue: ITTI, Room No. 411**

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## **Management of plastic wastes using catalysts**

**S. Akhter\*, A. Islam, S. Iqbal, R. Ahmed and M. Iqbal**

*Shahjalal University of Science and Technology, Sylhet, Bangladesh*

### **Abstract**

Bangladesh is facing a great challenge to meet its energy needs with the concurrent urbanization and industrialization day by day. A power crisis will develop in near future with the infrastructure of many existing power stations aging rapidly along with the increasing rate of fossil fuel price worldwide. So developing countries like Bangladesh must meet up the growing energy demand in an alternative but cost-competitive, responsible and sustainable manner. Production and consumption of plastic goods in Bangladesh is increasing day by day due to urbanization and industrialization. It is estimated that approximately 13,332 tons of waste is produced per day into urban areas of Bangladesh, which is over 4.86 million tons annually. It is projected that this amount will grow up to 47,000 tons per day and close to 172 million per year by 2025, due to growth in population and in per capita waste generation. The land filling area is limited because the value of land is very high. Fifty percent of used plastic were recycled and plastic waste is a great threat for of environment. The waste plastics were pyrolysed in a batch reactor using mixed oxide catalyst and a good amount of fuel were produced. The plastic wastes were collected different areas and sorted in different categories, treated at temperature 350C-45°C with mixed catalyst. The yield was 70% using catalyst and the calorific value was good of the produced fuel. The physical properties of the produced fuel were analyzed and discussed in this paper. Thermal treatment will be a good option for the waste management and for the environment.

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## **Non-oxide chalcogenide glasses: A versatile material for strategic and civilian applications**

**A. R. Molla**

*Glass Division, CSIR-Central Glass and Ceramic Research Institute, Kolkata, India*

### **Abstract**

Chalcogenide glasses are non-oxide in nature, synthesized by melting elemental raw materials in an evacuated sealed silica ampoule. Special types of rocking furnaces are used for melting such glasses. Detailed descriptions on synthesis techniques of chalcogenide glasses will be presented. Chalcogenide glasses are used for processing of raw diamonds to transform it from a dull, ugly stone to a most precious material on earth! A detailed account of this aspect will be covered in this presentation.

Amorphous chalcogenide glasses form the basis of re-writable CD and DVD in the solid state memory technology. Such glasses are also extensively used for military applications as night vision devices using its thermal imaging characteristics, in radars, laser devices as well as in the civilian applications. Lie detectors can be fabricated using such chalcogenide glasses. High end cars are fitted with lenses made of chalcogenide glass for Driver's vision enhancement. In brief, chalcogenide glasses feature unique characteristics which enable them to become an indispensable material for many advanced applications such as IR optical devices (transmittance in the IR region up to  $\sim 20\mu\text{m}$ ), host for ion-doped laser and amplifier (low phonon energy  $\sim 200\text{ cm}^{-1}$ ), ultrafast all optical switching for optical communications (high optical non-linearity), photocopy machines, digital x-ray imaging, PCM (semiconducting), thin film battery, ionic devices (fast ion conducting), photo lithography and optical waveguide (photo induced phenomena) to name a few.

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## Functional biomaterials for the treatment of low back pain

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### Abstract

Orthopaedic impairment is considered as the leading cause of social disability in the world. Among orthopaedic impairment low back pain (LBP) is the second leading cause of disability and a common reason for lost work days primarily caused by the degeneration of intervertebral disc (IVD) resulting in the compression of the spinal nerves and adjacent vertebrae. The IVD is confined by the two cartilage endplates and is composed of two distinct structures: a gelatinous nucleus pulposus (NP) center and several surrounding coaxial lamellae that form the inner and outer annulus fibrosus (AF). Degenerative disc disease (DDD) is defined as an “aberrant, cell-mediated response to progressive structural failure”, a structural disorganization of the NP and the AF which leads to a loss of disc height and herniation causing an overall effect on the biomechanics of the spinal column with age. Over 60% of the Indian adult population and an estimated 65% of worldwide population experience low back pain due to the degenerative IVDs at some point in their lives. Associated healthcare costs are in excess of \$100 billion globally. The prevalence of back pain will increase substantially in the coming years due to the ageing demographic. However, despite the prevalence of degenerated disc diseases (DDD) and its enormous socioeconomic impact current treatment options are limited for spinal reconstruction. Conventionally, metallic interbody spinal cages are being used in spinal fusion surgery but inferior osteoconductivity, corrosion, stress shielding effect of metallic spinal cage leads to severe pain and immature implant failure. Hence, in recent years several attempts have been made for developing osteoconductive nonmetallic spinal cage implants which can provide superior implant stabilization and faster spinal fusion. This lecture will present the prospect of developing bioactive polymer-ceramic composites and/or industrially viable plasma sprayed bioactive ceramics coated spinal cage implants which have showed to increase the ability to osseointegrate for potential spinal reconstruction application than conventional metallic spinal cage implants. Furthermore, the importance of regenerative approaches by combining biomaterials science and cell therapy that can possibly enable/stimulate the repair of the damaged disc will also be covered in this lecture.

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## Maghemite ( $\gamma\text{-Fe}_2\text{O}_3$ ) fine particles preparation from iron containing waste materials: studies/investigations on structural, morphological, thermal and magnetic properties

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<sup>2</sup>*Noakhali Science and Technology University (NSTU)*

### Abstract

Recovery of valuable materials from iron containing wastes is demanding as well as pivotal both from economic and environmental standpoints. Magnetic iron oxides are themselves a captivating world owing to their various applications in different fields especially biomedical, catalysis, storage devices, etc. This work proposes a rational synthesis of maghemite ( $\gamma\text{-Fe}_2\text{O}_3$ ) fine particles from iron containing slag, mill scale, scrap and iron dust waste sources by facile chemical precipitation



approach, processed with HCl, Na<sub>2</sub>CO<sub>3</sub> and NaOH, followed by calcination and also optimizing the pH value and calcination temperature during synthesis. Samples were characterized by XRD, FT-IR, TG/DTA, PSA, SEM, and VSM. The XRD and FT-IR results confirmed the formation of  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> particles, whereas their excellent stability was confirmed by TG/DTA studies. From particle size analysis (PSA), all of the  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> particles possessed a high specific surface area. The SEM micrographs showed that the  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> particles obtained from different waste sources were quite irregular, mostly of spherical shape, and agglomerated themselves and their sizes ranged in submicron level. In physical characterization, the room temperature hysteresis (M-H loop) revealed that all the particles were in the ferrimagnetic phase at room temperature. The investigated results suggest that the process is a feasible path for preparing  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> from iron containing waste materials.

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## **Method validation on iron determination by spectrophotometric method in aqueous medium**

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### **Abstract**

This paper deals with the validation of a method for the determination of iron in spectrophotometric method in aqueous medium. The method is based on complex formation of iron with thioglycolic acid (TGA) in alkaline medium in presence of a masking agent to produce a red purple chelate that has an absorption maximum at 535 nm wavelength. Beer's-Lambert's law is obeyed and linear calibration curves were obtained for the concentration range of iron from 0.1 mg/L to 30 mg/L. The reaction is found to be spontaneous in alkaline medium. The limit of detection (LOD) and limit of quantification (LOQ) for the developed method are 0.0108 and 0.0345 respectively. Effect of different parameters like molar ratio of iron to different reagents and interferences, effect of time and effect of temperature of this method of determination were studied. It is found that this method is moderately sensitive and has been successfully applied for the determination of iron (III) in different fields like ceramic materials, clay, sand, glass, stone, soil, water, and any inorganic iron containing compound or alloys. A comparison report is made for Chevron gas field waste material and Certified Reference Material (CRM) of iron, which was done by Atomic Absorption Spectrophotometer (AAS) and Ultraviolet-visible (UV-Vis) spectrophotometer and found to be comparable.

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## Decomposition pathways of $[\text{Ru}(\text{bpy})_3]^{2+}$ during photocatalytic water oxidation and its crystallographic study

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### Abstract

The development of homogeneous photocatalytic water oxidation system consists of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  as a photo pump,  $\text{S}_2\text{O}_8^{2-}$  as the sacrificial electron acceptor and a water oxidation catalyst. The limitation of this system is rapid decomposition of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$ , as a result the process stops before all of  $\text{S}_2\text{O}_8^{2-}$  is consumed. In this regard its decomposition pathways and the fate of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  should be elucidated to design more efficient photocatalytic water oxidation systems. At pH 6 or higher than that  $[\text{Ru}(\text{bpy})_3]^{3+}$  in one electron oxidation process oxidized water directly. In addition here we try to understand the actual end product generated from this light driven reaction. With the help of the crystal structure analysis of this end product was done to know the decomposition of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$ . There are two pathways exist for decomposition of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  in the light- $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$ - $\text{S}_2\text{O}_8^{2-}$  system. From the first minor, dark decomposition pathway formation of  $\text{OH}\cdot$  radicals at  $\text{pH} > 6$  attack the bpy ligand of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$ . During irradiation both of  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  and  $\text{Ru}^{\text{III}}(\text{bpy})_3^{3+}$ , the photoexcited  $\text{Ru}^{\text{III}}(\text{bpy})_3^{3+}$  reacts with  $\text{S}_2\text{O}_8^{2-}$  to produce an intermediate which decomposes into catalytically active Ru  $\mu$ -oxo dimers when the intermediate concentration is low or into catalytically inactive oligomeric Ru  $\mu$ -oxo species when the intermediate concentration is high. This is the major, light-induced decomposition pathway. So light- $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$ - $\text{S}_2\text{O}_8^{2-}$  system produces  $\text{O}_2$  when  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  concentration is low even without catalysts and when  $\text{Ru}^{\text{II}}(\text{bpy})_3^{2+}$  concentration is high, the system does not produce  $\text{O}_2$  because the overall rate for the light-induced decomposition pathway is much faster than that of the  $\text{O}_2$  producing dark pathway.

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**Technical Session-1D: Pharmaceutical Sciences**

**Session Chair: Prof. Dr. S. M. Abdur Rahman, DU**  
**Venue: ITTI, Room no. 612**

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## **Scopes and opportunity for new and generic drug developments in Bangladesh**

**M. H. Sohrab, F. Afroz, S. R. Rony, A. D. A. Shahinuzzaman, S. Sharmin, F. Moni, S. Akhter, S. Mollick,  
M. N. Uddin and M. A. Islam**

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### **Abstract**

Drug discovery is the process by which new candidate medications are discovered. Modern drug discovery involves the identification of hits and optimization of those hits to increase affinity, selectivity, efficacy/ potency, metabolic stability and oral bioavailability. Once a compound meets these qualities, the process of drug development begins, and, if successful, clinical trial is mandatory. Modern drug discovery research is thus usually a capital-intensive process that involves large investments by pharmaceutical industry as well as national governments. Despite technological advancements and improved understanding of biological systems, drug discovery research is still a lengthy, expensive, difficult, and challenging process with slow rate of new therapeutic discovery. BCSIR wants to avail the vast opportunity for development of new and generic drugs. So, we at BCSIR are implementing the project “Establishment of Institute of Bioequivalence Studies and Pharmaceutical sciences” to strengthen its ongoing drug discovery research. It is going to be a state of the art institute, creating facilities for bioequivalence studies, searching for new leads, cost effective synthesis of active pharmaceutical ingredients (APIs), quality improvement of medicine, de-formulation i.e., reverse engineering for export quality generic drug development, effective dosage form design etc. as well as related analytical services. Thus, BCSIR is opening a new scope and opportunities at Government level for development of new and generic drugs to facilitate the Pharmaceutical Industry of Bangladesh.

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## **Prospects, efficacy, safety and regulatory aspects of traditional & herbal medicines and food supplements in Bangladesh**

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### **Abstract**

According to WHO, 70-80% of rural people of Bangladesh use traditional medicines in some stage of their illnesses. Ayurvedic, Unani, Homeopathic medicines, plants/herbs offered by traditional healers (Kabiraj/ Hakim), and herbal plants used by ethnic and general people for the cure and treatment of their own diseases based on traditional knowledge are different forms and practice in Bangladesh. Because of tremendous side-effects, high cost, drug resistance, ineffectiveness or unavailability of drugs for treating some diseases (such as cancer, Alzheimer diseases, autoimmunity, etc.) lead to therapeutic approaches to traditional and herbal medicines. Likewise, nutraceuticals and food supplements are also popular and extensively used by the people irrespective to urban or rural areas. Although those medicines are extensively practiced and used by the patients in Bangladesh, scientific evidences on efficacy, acute and chronic toxicity, standardization of those preparations are scarce. Besides, microbial contamination, adulteration and improper application of GMP in the manufacturing of traditional, herbal medicines and nutraceuticals are also remarkable areas yet to improve. The objectives of the presentation are i) to highlight the



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prospects, ii) to justify and rationalize the necessity of scientific studies for efficacy and safety/toxicity, iii) to highlight the scopes of development of new therapeutics from traditional, herbal medicines, nutraceuticals and functional foods through research and development, and iii) to discuss the regulatory issues of traditional and herbal medicines, nutraceuticals and food supplements manufactured, practiced and used in Bangladesh to solve the current problems. This presentation will be helpful for the manufacturers, researchers, policy makers, practitioners, drug control authority and users of traditional, herbal, nutraceuticals and food supplements to have a clear idea about the strength and weakness of those products and practices in Bangladesh as an alternative to modern Allopathic medicines for future improvement and better prospects.

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## **Cardioprotective and nephroprotective effects of canagliflozin in isoprenaline-induced oxidative injury: role of AMPK, Akt-eNOS-NO signaling**

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### **Abstract**

The antidiabetic drug canagliflozin has been reported to possess protective effects on the cardiovascular system but mechanisms involved remain unclear. The current study was undertaken to investigate protective effects of canagliflozin in isoprenaline (ISO)-induced cardiac and renal oxidative stress and underlying molecular mechanisms. Our tissue biochemistry, histology and Western blotting data showed that ISO administration inflicted pro-oxidative, pro-inflammatory and pro-apoptotic changes in the heart and kidney tissues. Treatment with canagliflozin at 5 mg/kg body weight attenuated levels of cardiac and renal oxidative stress markers including malondialdehyde (MDA), advanced protein oxidation product (APOP), myeloperoxidase (MPO) and nitric oxide (NO), and restored levels of endogenous antioxidant molecules such as catalase (CAT), superoxide dismutase (SOD) and glutathione (GSH) that were depleted in ISO-treated rats. Western blot analysis revealed that canagliflozin increased activity of anti-oxidant/anti-inflammatory proteins such as AMP-activated protein kinase (AMPK), Akt and eNOS, and decreased pro-oxidative/pro-inflammatory proteins including iNOS and NADPH oxidase isoform 4 (NOX4). Protein expression analysis also revealed that ISO elevated the ratio of pro-apoptotic/anti-apoptotic protein (Bax:Bcl-2) expression, which was significantly reduced by canagliflozin treatment. Consistently, our histological examination demonstrated that in the heart and kidney tissue sections canagliflozin attenuated ISO-induced histopathological changes, including inflammatory cell infiltration, collagen deposition, and fibrosis. In summary, our data suggest that canagliflozin produces cardioprotective and renoprotective actions via AMPK, Akt-eNOS activation, and suppression of iNOS, NOX4 and Bax expression.

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## Synthetic studies towards scaffold-based CXCR4 antagonists

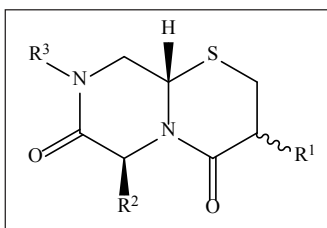
M. M. Hussain<sup>1\*</sup> and B. E. Haug<sup>2</sup>

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### Abstract

Chemokine receptor 4 (CXCR4) plays an important role in many pathological conditions such as tumor growth, metastasis, rheumatoid arthritis, and HIV-1, thus CXCR4 antagonists have been established as a potential therapeutic agent for the treatment of various diseases. The aim of this research work was to prepare of novel CXCR4 antagonists based on established minimalistic 3D pharmacophore model of bicyclic compounds and all the target molecules consists of three essential side chains grafted on a rigid bicyclic scaffold.



A potential synthetic route for linear precursors such as three building blocks grafted on to a bicyclic scaffold to assembly of the final target molecules (CXCR4 antagonists) have been prepared. Nine analogues of the CXCR4 antagonists have been synthesized with variation of the constituents in the building blocks. It has been proven that the aromatic linker side chain is an essential part for avoiding a competition of Pictet-Spengler reaction. The cyclization step of the final target molecules has been identified and the configuration of the structure with stereo-chemical outcome of the target molecules have been elucidated with accommodation of established 3D pharmacophore model for CXCR4 antagonistic activity.

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## Mimosine shows ER $\alpha$ -mediated estrogenic activity on MCF-7 breast cancer cell line

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### Abstract

Hormone replacement therapy has been a conventional treatment for postmenopausal symptoms in women. However, it has potential risks of breast and endometrial cancers. The aim of this study was to evaluate the estrogenicity of a plant - based



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compound, mimosine, in MCF - 7 cells by in silico model. Cell viability and proliferation, ER $\alpha$  - SRC1 coactivator activity and expression of specific ER $\alpha$  - dependent marker TFF1 and PGR genes were evaluated. Binding modes of 17 $\beta$  - estradiol and mimosine at the ER $\alpha$  ligand binding domain were compared using docking and molecular dynamics simulation experiments followed by binding interaction free energy calculation with molecular mechanics/Poisson–Boltzmann surface area. Mimosine showed increased cellular viability (64,450 cells/ml) at 0.1  $\mu$ M with significant cell proliferation (120.5%) compared to 17 $\beta$  - oestradiol (135.2%). ER antagonist tamoxifen significantly reduced proliferative activity mediated by mimosine (49.9%). Mimosine at 1  $\mu$ M showed the highest ER $\alpha$  binding activity through increased SRC1 recruitment at 186.9%. It expressed TFF1 (11.1 - fold at 0.1  $\mu$ M) and PGR (13.9 - fold at 0.01  $\mu$ M) genes. ER $\alpha$  - mimosine binding energy was -49.9 kJ/mol, and it interacted with Thr347, Gly521 and His524 of ER $\alpha$  - LBD. The results suggested that mimosine has estrogenic activity.

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## Presence of antimicrobial agents in marine organisms

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### Abstract

A large portion of marine organisms produce a diverse range of chemicals to defend them. In recent studies, several marine organisms have been found to contain antibacterial and antifungal agents that are effective against numerous species of microorganisms. A new compound sarcophylotide was extracted from soft coral *Sarcophyton sp.* collected from the intertidal areas and the fringing coral reefs near Hurgada, Red Sea, Egypt. This compound was found to exhibit broad antimicrobial activity, particularly towards *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Candida albicans* and *Saccharomyces cerevisiae*. Crude methanolic extracts of *Sinularia compressa* (soft coral), *Petrosia sp.* and *Psammaphysil lapurpurea* (sponges) were found to be effective against strains of *Bacillus cereus*, *Bacillus circulans*, *Bacillus pumilus*, *Pseudomonas vesicularis* and *Pseudomonas putida*. Several species of sea cucumbers also display antimicrobial activity. Three species of sea cucumbers found in Sabah coastal area of Malaysia were screened for antimicrobial activity and found active against a wide range of Gram-positive and Gram-negative bacteria. Crude extracts and semi-purified fractions from the Mediterranean Sea cucumber, *Holothuriapolii*, collected from the bay of Tabarka, Tunisia coast were screened for antifungal activity against three filamentous fungi (*Aspergillus fumigatus* IP 1082.72, *A. fumigatus* IP2279.94 and *Trichophyton rubrum* IP 2043.92) and two yeast species (*Candida albicans* IP 48.72 and *Candida albicans* IP 884.65). The results of these reports indicate that there are substantial prospects of finding effective antimicrobial agents from many different marine organisms. Through investigation of closely related species of the organisms noted above could yield new compounds that may be effective against pathogens that have become resistant to conventional form of drugs.

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**Technical Session-2A: Pulping and Bleaching-2**

**Session Chair: Prof. Jing Shen, NEFU  
Venue: ITTI, Room no. 611**

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## Non-wood anatomy research-Bangladesh perspective

A. K. M. G. Sarwar\* and Md. A. Hossain

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### Abstract

Natural (plant) fibres are the source of raw materials for pulp and paper industries. Although wood fibre has recently been introduced for paper pulp making, it occupies the lion share in global raw material supply. The rapid decrease in natural/plantation and homestead forests enforces pulp industries to find out new sources of raw materials. Non-wood fibres i.e., bast (phloem) fibres and fibres from other sources, has re-gained its popularity and become one of the important alternative sources of fibrous material for the 21st century. Agricultural wastes may be an important candidate and sustainable source for non-wood (paper making) fibres. Pulps from some agricultural residue take less time to cook than wood pulps. That means agricultural-based paper uses less energy, less water and fewer chemicals. For example, pulp made from wheat and flax straw has half the ecological footprint of pulp made from forests. Plant anatomy as a discipline has been taught at different universities of Bangladesh; however, a few research works has been conducted on this topic. The non-wood anatomy in some cases used as a tool of taxonomic identification. As a part of comparative and/or developmental anatomical studies of different crop species, a number of researches have been conducted at the Department of Crop Botany, Bangladesh Agricultural University. This knowledge could be helpful for the researchers to identify eco-friendly and climate smart non-wood fibre sources for sustainable pulp production.

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## Effect of prehydrolysis on kraft pulping of kadam (*Anthocephalus chinensis*) –a hardwood species abundantly grown in Bangladesh

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### Abstract

Research has been carried out all over the world for improvement of pulping process concerning environmental aspect and economic benefits. In this study kadam (*Anthocephalus chinensis*) chips was hydrolysed with  $\text{Na}_2\text{CO}_3$  (3% based on OD chips) for an hour maintaining  $140^\circ\text{C}$  to reduce cooking chemicals and pulping time. The hydrolysate was removed and the chips were used for making kraft pulp. Three active alkali doses (14, 16 and 18%) on chips were used to obtain various levels of delignification. The pulping temperature was maintained at  $170^\circ\text{C}$  with the variation of pulping time for 45 min, 60 min and 90 min. It was found that with the increase of alkali doses and pulping time the kappa number reduced, simultaneously pulp yield was also lowered. Bleachable grade pulp can be obtained by pulping 45 min with 18% active alkali. At this condition pulp yield was 50%. Prehydrolysis prior pulping would save pulping time and cooking chemicals. The sheets from prehydrolysed kraft pulp were made and the physical strength properties likely tear, tensile and burst were evaluated. The pulp quality is slightly inferior compared to the untreated pulp. However this pulp could be useful for producing specialty paper-related products. Further research on the production of value added chemicals from hydrolysate and nano products from the pulp is recommended.

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## Valorization of wheat straw aiming at biorefinery concept

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### Abstract

India is the second largest producer of wheat in the world after China. Every ton produces 1.4 to 1.5 t of straw which aggregates to about 110 Mt of wheat straw. Paper industry utilizes this straw for the production of paper. However, during pulping most of the hemicelluloses gets washed away in black liquor along with lignin. This black liquor is burnt in chemical recovery boilers for the production of steam and electricity. However, it is inefficient to burn hemicelluloses as they have low heating values than lignin. Present study aims to capture these hemicelluloses prior to pulping through mild acidic pre-treatment. The pre-treatment was carried out at 121°C for 60 & 120 minutes with 0.05-0.2N H<sub>2</sub>SO<sub>4</sub>. The solid to liquor ratio was kept at 1:15. The extracted liquor was analyzed for total reducing sugars via UV-Vis Spectrophotometer and HPLC. The solid residue after extraction was utilized for pulping and hand sheets making. Pulp yield, rejects, screened pulp yield and kappa number of the pulp were evaluated. The results depicted an increase in pulp yield of the pre-extracted straw however the kappa number was also increased. The tensile index of the pre-extracted straw pulp was decrease considerably however there was a marginal decrease in the tear and burst indices. Incorporating an additional pre-extraction stage in paper mill may provide some additional revenue by processing the extracted hemicelluloses into biofuel or other value added products.

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## Modification of cotton fibre with functionalized silane coupling agents

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### Abstract

Modification of cotton fibre was studied by condensation polymerization with functionalized silane coupling agents like vinyltrimethoxysilane (VTMS) and aminopropyltriethoxysilane (APTES) in ethanol/water system. The modification of cotton fibre enhanced the tensile properties, water repellency, wrinkle recovery due to higher flexibility of Si-O bond and fibre matrix interfacial strength properties. The swellability of modified cotton fibre was decreased in aqueous solution which affect the overall chemical phenomenon of the fibre. The use of sodium dodecyl sulfate as a surfactant in ethanol/water medium accelerate the dispersion of VTMS and APTES which accelerates the hydrolysis, condensation as well as the fibre surface functionalization. The optimized condition of modification for VTMS and APTES was 600% and 300% in ethanol/water mixture (60:40) containing surfactant at pH 3.5 and at 400 C in the fibre-liquor ratio of 1:40. The modified cotton fibre was subjected to evaluate some of the properties like swelling behavior in different solvents and moisture absorption. It was observed that swelling behavior and moisture absorption of modified cotton fibres were decreased in polar solvents whereas increased in nonpolar solvents. Fourier transform Infrared spectroscopy was used to identify the incorporation of silicon containing species, Energy Disperse X-ray analysis determine the quantities of atomic silicon which directly reflects it's valence bond with organic moieties, Scanning electron microscopy and thermogravimetric analysis were used to investigate the surface morphology and thermal behavior of the modified fibre respectively.

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## Biorefinery initiative of *Casuarina equisetifolia* by formic acid

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### Abstract

Bangladesh is very much successful in coastal afforestation programmes, which protected from frequent cyclones. *Casuarina equisetifolia* has showed a climate resilient and promising species in the coastal sandy beaches. The species may be suitable for industrial raw material. But no study has been done on industrial application of *C. equisetifolia* in Bangladesh. In this study, *C. equisetifolia* characterized in terms of chemical, morphological and anatomical properties. It is characterized with higher  $\alpha$ -cellulose, similar, hemicelluloses and lignin as compared to other hardwood species grown in Bangladesh. The *C. equisetifolia* wood is constituted with fiber, vessel and ray cells and its fiber was shorter in length. The *C. equisetifolia* was also fractionated by formic acid (FA) at atmospheric pressure to pulp, dissolved lignin and hemicelluloses. Pulp yield was 50% with kappa number of 40 at the conditions 3 h treatment with 90% FA followed by 2 h peroxyformic acid treatment. The pulp was bleached by alkaline peroxide bleaching and produced brightness of 87%. The papermaking properties were in acceptable range. The dissolved lignin and hemicelluloses was easily separated from spent liquor, which can be used for biomaterials and biofuel. Finally, it can be said that *C. equisetifolia* is promising species for biorefinery.

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**Technical Session-2B: Pulping and Bleaching-3**

**Session Chair: Prof Dr. M. N. Alam, Lakehead University, Canada  
Venue: IFRD Auditorium**

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## Trends and technology advancements in paperboard packaging in China

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### Abstract

Packaging board has the largest tonnage among the fiber-based products. Packaging board has some room to increase, the production continues to grow because of the E-commerce and new economic development. The trends of the packaging is the light weighting and circular economy. The main drivers of packaging board are the major brand owners/retailers requirements and governmental regulations. The main raw materials of packaging board is the recycled fiber, the recycled fiber faced challenges because of the restrict regulations of Chinese government. New alternative fibers should be found out to meet the raw materials requirements. The technical trends of packaging board are the performance & functionalities of the products, using of new biomaterials in the packaging board, starch addition to improvement strength. The liquid packaging board performance was evaluated by adding BCTMP pulp.

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## Durable cationic surface modification of cotton fabric: a green approaches for protective textiles

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### Abstract

The health protection of human being is the main concern, but current textiles possess no or poor antimicrobial activity. In the present work, cotton fabric was successfully modified with ZnO loaded chitosan derivatives such as N-(2-Hydroxy) propyl-3-trimethylammonium chitosan chloride (HTACC) and N-methylolacrylamide-N-(2-hydroxy) propyl-3-trimethyl ammonium chitosan chloride (NMA-HTACC) to impart cationic charge on fibre backbone by using covalent bond. Efficient ZnO loaded chitosan derivatives was determined using UV-spectroscopy, and modification was confirmed using Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and thermogravimetric analysis (TGA). To evaluate the antimicrobial activity of unmodified and modified fabrics, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined in terms of bacterial reduction (%). The study indicated that the cationic charge density as well as the add-on percentage of polymer greatly influenced the antibacterial activity and incorporation of zinc oxide component into the polymer greatly enhanced the bacterial anti-adhesion and UV-protection of the treated fabrics due to the low surface energy induced hydrophobicity of the fabrics. In addition, wash durability, water vapour transmission rate (WVTR), wicking test, tensile strength, swelling and biodegradation test of unmodified and modified cotton fabrics were evaluated. The modified fabrics were retained its antimicrobial activity up to 29 laundry wash and showed improved physico-chemical textile properties. The obtained data strongly encourage the use of the metal oxide encapsulated composites for durable antimicrobial textiles which can be applied in medical, hygiene, hospital as well as in personal healthcare.

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## **Study the effect of inherent sulfur and its salts during pyrolysis of Kraft lignin isolated from linerboard and bleach grade black liquors**

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<sup>6</sup>*Institute of Fuel Research and Development, Bangladesh Council of Scientific and Industrial Research, Dhaka-1205, Bangladesh*

### **Abstract**

To observe the catalytic effect of inherent sulfur and its salts in lignin during pyrolysis, total six lignin samples were isolated from Loblolly pine linerboard and bleach grade Kraft pulping black liquors. Inorganic elements present in all lignin samples were analyzed by ICP analyzer. The raw lignin samples contain large amount of inorganic elements, especially Na and S, than LignoBoost™ and acid precipitated lignin samples. The ash contents in raw lignin samples were higher (~40%) because of the presence of different inorganic elements. Pyrolysis testing of these lignin samples have been carried out at 600°C. The raw lignin samples led to higher pyrolysis yield, due to presence of inorganic elements. Pyrolysis oils were analyzed by <sup>13</sup>C, HSQC-NMR, and GPC. For the raw lignin samples, more methoxyl groups and ether bonds were broken, resulting in less methoxyl groups and aromatic C-O bonds, and lower Mw and Mn in their pyrolysis oil. This study reveals that the sulfur, present in lignin enhances the lignin pyrolysis process via catalytic mechanism.

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## **Low temperature potassium hydroxide pulping of straw**

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### **Abstract**

The present research is focused on the pre-extraction of rice straw and wheat straw by potassium hydroxide (KOH) at 90°C prior to pulping in order to remove silica and partial removal of lignin and hemicelluloses. Pre-extraction removed 76% and 73 % lignin, 50.5% and 26.8% pentosan and 81% and 87% silica from the rice and wheat straw, respectively. Pre-extracted rice straw and wheat straw were subjected to KOH pulping by varying KOH charge (6, 8, 10 and 12% as NaOH), time (60, 90 and 120 min) and temperature (70 and 90°C). Pulp yield of 43.6% and 51.0% with kappa number 16.2 and 20.2, for rice straw and wheat straw, respectively, was obtained at the condition of 12 % alkali for 120 min of cooking at 90°C. KOH rice straw and wheat straw pulp bleached to 76.8 % and 80.1% brightness, respectively, by D<sub>0</sub>E<sub>p</sub>D<sub>1</sub> bleaching sequences with ClO<sub>2</sub>



consumption of 25kgClO<sub>2</sub>/ton of pulp. The papermaking properties were inferior to that of corresponding pulps from higher temperature cooking. Dissolved silica, lignin and hemicelluloses were separated from the spent cooking liquor and potassium rich liquor was used for soil amendment.

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## **Development of Chemometric models for the chemical characterization of non-wood by FT-NIR spectroscopic data**

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<sup>2</sup>*Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh*

### **Abstract**

In this study, a model for prediction of lignocellulose components of agricultural residues has been developed with FT-NIR spectral data. Two calibration techniques Principal Component Regression (PCR) and Partial Least Square Regression (PLSR) were assessed for prediction of Lignin, Holocellulose,  $\alpha$ -cellulose, Pentosan and Ash, and found PLSR better for Lignin, Holocellulose and  $\alpha$ -cellulose. PCR also produced better results for quantification of Pentosan and Ash. Spectral range 7000-5000cm<sup>-1</sup> shows more informative than other parts of the spectral data. The PLSR shows maximum R<sup>2</sup> value (R<sup>2</sup>=0.91%) for prediction of Holocellulose. For the prediction of Pentosan, PCR was better (R<sup>2</sup>= 0.68%). PCR also shows better results (R<sup>2</sup>= 86%) for quantification of Ash. To determine amount of Lignin, PLSR was the best (R<sup>2</sup>= 0.83%) when the spectral data are de-trained and smoothed with Savitzky-Golay (S-G) filtering simultaneously. For prediction of  $\alpha$ -cellulose, PLSR was the best model (R<sup>2</sup>=0.94%) when the data were pretreated with mean normalization. Considering the best alternatives in NIR data preprocessing and calibration techniques, methods for quantification of lignocellulose components of agricultural residues have been developed which is rapid, cost effective and less chemical intensive and easily usable in pulp and paper industries and pulp testing laboratories.

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**Technical Session-2C: Ceramics and Biomaterials**

**Session Chair: Dr. Husna Parvin Nur, BCSIR**  
**Venue: ITTI, Room no. 411**

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## Advanced ceramics: A next generation ceramic for sustainable development

A. K. M. A. Hakim

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### Abstract

Breaking out the barrier of knowing glass and ceramics as just window, tableware and bricks, we are now living in an era of modern technology where these two inorganic classes of materials have become the center of the interest to all scientific communities. In the span of two centuries of research, the current research trend has shifted from traditional ceramic/glass to more advanced materials such as bullet-proof ceramic/glass, self-cleaning ceramic/glass surface, thermal barrier coating, energy harvesting glass, antibacterial ceramic tiles and sanitary wares just by introducing nanomaterials as coating on traditional materials. The term “energy consumption” makes us worried than ever since global warming has become a threat to our existence on mother earth. The quest for new materials having lower energy consumption has endowed us with modern ceramic materials like quantum dot LED, multifunctional magnetic semiconductor type spintronics materials for ultrafast charge transfer mechanism in smart devices, high temperature ceramic superconductors. Microporous ceramic materials quantum dot sensitized solar cell, nuclear ceramic for fuel/ control rod, including nuclear waste immobilization, bioceramics in medical, H<sub>2</sub> production by water splitting with ceramic photo-catalysts, ceramic paint/link are recent research trends in Ceramics. The photo-catalytic and photo thermal effects of nanoceramics has emerged as a sustainable solution to pure water crisis and environmental pollution. Nanoceramic materials are now considered as the potential candidate to fight against cancer, parkinson’s disease and antibiotic resistance of bacteria. This presentation will briefly focus on the current research enthusiasm on advanced ceramics in Bangladesh and around.

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## Nanoporous $\gamma$ -alumina thin and thick films humidity sensors for Industrial applications

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### Abstract

Nanoporous  $\gamma$ -alumina thin and thick films were prepared by sol-gel route using fullerene as pore former. An alumina sol was prepared from aluminium sec. butoxide and 2% (w/v) ethanol dispersed fullerene was added to the alumina sol. The fullerene was dispersed using triton X-100 [Vukosava et al., 2011]. Thick films were prepared by gel casting process and thin films were developed by dip coating process. The adsorption studies (BJH) show average pores of radius  $\sim$  0.4-8.0 nm, pore volume of 0.40 cc/g and surface area is 150.00 m<sup>2</sup>/g. However, in fig.1 (AFM image) some big pores are also present probably due to the presence of agglomerated fullerenes in the alumina gel matrix.

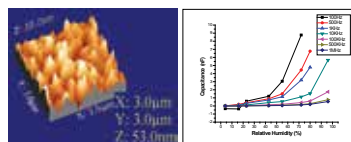


Fig.1 AFM image of  $\gamma$ -alumina thick film; Fig.2. Relative Humidity vs Capacitance plot at different frequencies

In humid atmosphere, capillary condensation takes place in all the pores with radii smaller than the kelvin critical radius given below:

$$r_k = \frac{2\sigma M_v \cos \theta}{P_s RT \frac{P_v}{P_s}} \text{-----(1)}$$



where  $\sigma$  in the surface tension, in the contact angle,  $M_v$  in the molecular weight of the vapour,  $P_v$  is the density of vapour,  $P_v$  is the instantaneous vapour pressure and  $P_s$  is the saturation vapour pressure. The capacitance of the layer changes due to the change in permittivity as a function of vapour uptake and depends on ambient vapour concentrations [Eliassi and Ranjbar, 2014].

For the electrical measurement Ag-Pd and gold paste were screen-printed on thick and thin films. After drying in air, the films were calcined at 850°C with a heating rate of 40°C/h (soaking for 1 hour) to obtain crack-free porous thick and thin films alumina dielectric [Chengbin et al., 2007]. The variation of capacitance with humidity has been shown in fig. 2. The sensitivity, linearity and response depend on pore morphology and thickness of the dielectric layer and geometry of the electrodes [Das et al., 2014]. Further studies are required to control the pore size & distribution of pores to get response at low humidity ambience with temperature and pressure variation.

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## **Effect of 93% Fe<sub>2</sub>O<sub>3</sub> content waste iron on physical, mechanical and micro-structure properties of Ceramic tiles**

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### **Abstract**

Recently Ceramic tiles are very popular in world because of their excellent physical, mechanical and chemical properties. Ceramic tiles were made by mixing certain amount of Bijoypur clay, quartz and different amount of waste iron which contains higher percent (above 90) of Fe<sub>2</sub>O<sub>3</sub> and K-feldspar. The samples were fired at different temperatures in the range 1075 – 1225 °C with soaking time of 1h and the physico-mechanical and others properties were investigated. The results indicate that the combination of waste iron and K-feldspar was given comparable good results and it is used as subsidiary raw material in ceramic mixture. The use of waste iron in the standard wall and floor tiles composition decreases the firing shrinkage, increase the water absorption values and modulus of rupture.

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## **Synthesis and characterization of magnetite nano particles**

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### **Abstract**

Magnetite (Fe<sub>3</sub>O<sub>4</sub>) nano particles were synthesized by a simple co-precipitation method using ferric and ferrous salt as a precursor. The synthesized nano magnetite were characterized by X Ray Diffraction (XRD), Field Emission Scanning Electron Microscope (FESEM), Energy Dispersive X-Ray Spectroscopy (EDS or EDX), Fourier transform Infrared Spectroscopy





(FTIR). Magnetic property also checked by magnetic bar manual test. The result of XRD characterization was indicated that the produced magnetite powder has face centered cubic crystal structure with high crystallinity. Micro structure of the nano particles from FESEM showed that the magnetite nano particles are homogenous and spherical in shape. Chemical microanalysis by EDS confirmed that the synthesized products are fully composed of iron and oxygen. The type of precursor, Ionic solution concentration, molar ratio of the reactants, temperature, pH, stirring rate are the determinant factors to control the size of the nano particles. The main aim of this research was to establish an innovative way to prepare pure and good crystalline magnetite nano particles.

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## **Synthesis and characterization of zsm-5 zeolite sourcing silica from coconut shell using hydrothermal method**

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### **Abstract**

H-ZSM-5 zeolites were synthesized by hydrothermal method using silica extracted from waste coconut shell and aluminium nitrate. The utilization of waste coconut shell as a cost-effective and available source of silica in the preparation of valuable catalyst is a new attempt. TPABr was used as a structure directing agent in this synthetic process. The extracted silica from coconut shell was in amorphous phase confirmed from the XRD pattern. The optimization study suggested 150 °C and 60 hours as optimum condition for the synthesis of zeolite with pure MFI phase that was supported by the results of XRD and FTIR SEM-EDS. The prepared ZSM-5 using extracted silica were characterized by XRD, FTIR, SEM-EDS and XRF techniques. The XRD data of synthesized ZSM-5 showed crystalline MFI phase. The SEM image stated the poly crystalline zeolite containing rod shaped particles in small size. The XRF data revealed the major abundance of silicon and aluminium in the prepared ZSM-5 with lower Si/Al ratio (7.30). Therefore, the prepared zeolite (ZSM-5) and its protonated form are expected to have selective catalytic property.

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## **Characterization of red clay for refractory material applications**

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<sup>2</sup>*Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh*

### **Abstract**

In this research work red clay sourced from Naogaon district of Bangladesh was investigated to determine its suitability for refractory application. Mineralogical analysis was conducted by x-ray diffraction technique. The chemical analysis and property tests like permanent Linear charge on reheating, plasticity index, refractoriness, thermal shock resistance, refractoriness under



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load, thermal conductivity, bulk density, apparent porosity, water absorption and cold crushing strength were carried out using standard technique to characterize the red clay. The evaluation of properties showed that produced bricks possess better insulating characteristics, low water absorption 4.58%, low porosity 13-15%, high bulk density 2.94 gm/cm<sup>3</sup>, cold crushing strength 369.11 kg/cm<sup>2</sup>, permanent linear change 3.10% and better refractoriness 1200°C compared to conventional bricks. The results show that red clay can only be suitable for lining in the furnace or slag pots due to the lower thermal shock cycles; and for heat treatment oven that cannot be fired higher than 1200°C. A comparative study shows that the quality of this brick is comparable with the commercial one. Since local materials were used, the proposed method can be a potential low cost, environment friendly and sustainable technique for the production of high-quality fire bricks for Bangladesh.

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## **In situ synthesis of silver nanoparticles on polymer matrix using water in oil microemulsions for advanced applications**

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### **Abstract**

Nanostructured metal (NP) on polymer matrix reveal synergism of properties of initial components, which gives rise to specific electrical, mechanical, optical and chemical properties related to an ordered distribution of NPs over polymer matrix. Here, nanostructured silver (AgNP) was prepared by reduction method from aqueous and water in oil microemulsions of different surfactants, cetyltrimethylammonium bromide (CTAB), sodium dodecyl sulfate (SDS) and triton X-100 (TX-100). Microemulsions were prepared using SDS/CTAB/TX-100, 1-pentanol, benzene/cyclohexane and water as surfactants, co-surfactant, non polar and polar media, respectively. AgNPs were prepared in CTAB microemulsions with fixed water to surfactant ratio (Wo). Dynamic light scattering (DLS) method was used to measure average particle sizes of AgNPs. AgNPs prepared from TX-100 and SDS were stable over CTAB microemulsions. Stability of AgNPs was confirmed through aggregation kinetics by measuring the absorbance at definite time intervals at  $\lambda_{max}$  of AgNPs under pseudo-first-order conditions. Different parameters were optimized to ensure formation of stable AgNPs without aggregation in microemulsions by studying aggregation behavior at different  $[AgNO_3]:[NaBH_4]$  and Wo. Additionally, an attempt has been made to prepare Ag/PVA nanocomposites where AgNPs and poly(vinyl)alcohol (PVA) were used as disperse phase and matrix phase, respectively to control size and stability of AgNPs. Nanostructured Ag/PVA composites were confirmed by UV-spectrophotometrically. Average sizes of Ag/PVA prepared from SDS microemulsions were very smaller than that of aqueous solution. When 0.87% PVA was added to SDS microemulsion, average sizes of Ag/PVA nanocomposites were smaller than that of SDS microemulsions without PVA. Further techniques will also be used to observe structural properties of these PVA nanocomposites.

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**BANGLADESH JOURNAL OF SCIENTIFIC  
AND INDUSTRIAL RESEARCH**

**Technical Session-2D: Pharmaceutical Sciences**

**Session Chair: Dr. Md. Hossain Sohrab, BCSIR**  
**Venue: ITTI, Room No. 612**

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## Need for Chemistry education for developing countries

R. U. A. Khan

Vice President, API Unit, Incepta Pharmaceuticals Ltd., Bangladesh

### Abstract

Chemistry has proven to be an inevitable component for the growth of developed nations and now, it is equally important for developing countries. It has changed the life of human beings in all disciplines of life and has played a vital role in improving life of people right from good health to mortality rate especially achieved in pharmaceutical Industries and in particularly other industries. No industry can achieve a proper growth without chemistry. So, the Chemistry education should be designed according to the need of growing industries in the nation and an interest for the Chemistry among the student has to be created.

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## Evaluation of Antioxidant, Antidiabetic and Organoprotective effect of Australian Lupin Cultivars: *In vitro*, *in vivo* and *in silico* approaches

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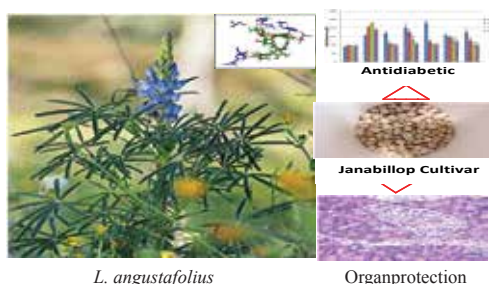
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<sup>3</sup>University of Science and Technology Chittagong, Bangladesh

### Abstract

Biofunctionalities of nine Australian Lupin cultivars were investigated and compared in this research. Both *in vitro* and *in vivo* studies of processed and unprocessed lupin seeds flours were done for antioxidant, antidiabetic and organoprotective potential. 7 *in vitro* and 3 *in vivo* antioxidant assays were conducted and it was found that both albus and angustifolius species have potential antioxidant activities whereas antioxidant activity of lupins may be due to the existence of flavonoids rather than the phenolic contents. On the otherhand, processing (cooking) of lupin flours also affect the antioxidant property. In case of anti diabetic experiments, *L. angustifolius* showed promising inhibition of alphaamylase and alphaglucosidase enzymes. Among the cultivars, Jenabillop found to be most potent against both enzymes. Janabillop also increase the Glucose uptake in to the skeletal muscle in rat model. Both processed and unprocessed extracts of Jenabillop at the dose of 500 mg/kg showed effective role in controlling blood glucose level in alloxan induced diabetes rat. Jenabillop extract also significantly protect alloxan induced organ damage which was clearly observed in histopathologic studies. *In silico* ADMET, molecular docking and simulation studies of metabolites from LC-QTOF-MS/MS study also correlated the *in vitro* and *in vivo* results.

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## Leaf extracts of *Citrus assamensis* show significant antinociceptive, antipyretic and neuropharmacological activities

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### Abstract

*Citrus assamensis* leaf extracts displayed marked dose dependent antinociceptive potential in the five pain models of Swiss albino mice in our study. Methanol and ethanol extracts except (200 mg/kg body weight) produced significant (\*\* $p < 0.01$ , \*\*\* $p < 0.001$ ) antinociception against thermal induced pain stimuli in mice at various time points of post treatment in hot plate study compared to the control group. In acetic acid induced writhing assay, methanol (100 mg/kg body weight) and chloroform (200 mg/kg body weight) extracts showed significant ( $p < 0.01$ ) result. In tail immersion test, basal reaction time was found significant ( $p < 0.01$ ) in case of ethanol (100 mg/kg body weight) and chloroform (200 mg/kg body weight) extracts compared against control. Both the doses of all the extracts exhibited significant (\*\*\* $p < 0.001$ ) activity in formalin induced paw licking as well as percent inhibition of glutamate induced writhing study. Both the doses of methanol and ethanol extracts showed significant ( $p < 0.05$ ) results in decreasing in rectal temperature after 1 hr. Higher doses of all the extracts showed significant ( $p < 0.05$ ) decrease in duration of immobility in forced swimming test. The higher dose of ethanol extract (200 mg/kg body weight) significantly ( $p < 0.05$ ) decreased the rate of movement with time in open field test. The test samples displayed marked antinociceptive potential in all the test procedures and also displayed marked antipyretic and neuropharmacological activities at different test doses.

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## Bioactive Compounds from an Aquatic Plant and its associated Endophytic Fungi

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### Abstract

Six endophytic fungi were isolated from the leaves and roots of an aquatic plant *Aponogeton undulatus* Roxb.. Strain AULE-1, AULE-2, AULE-3, AURE-1, AURE-3 and AURE-4 were morphologically identified as *Trichoderma* sp., *Carvularia* sp., *Penicillium* sp., *Fusarium* sp., *Mucor* sp., and *Fusarium* sp., respectively. Strain AURE-4 was further identified as *Fusarium solani* by DNA sequence analysis based on mega BLAST program. Preliminary bioactivity data suggested *Fusarium solani* as the potential source of bioactive compounds. Chemical investigation of the ethyl acetate extract from the culture of *Fusarium solani* led to the isolation of one new naphthoquinone 9-desmethylherbarine (1), and two azaanthraquinone derivatives,



7-desmethyloscorpinone (2) and 7-desmethyl-6-methylbostrycoidin (3). Four known compounds fusarubin (4), anhydrofusarubin (5), javanicin (6) and cerevesterol (7) were also identified. Their structures were elucidated by spectral analysis and a direct comparison of spectral data with those of known compounds. Azaanthraquinones 2 and 3 showed cytotoxic activity against four human tumour cell lines, MDA MB 231, MIA PaCa2, HeLa and NCI H1975. A molecular docking study suggested DNA intercalation as the mode of action of these naphthoquinones and azaanthraquinones.

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## Phytochemical Screening and Antibacterial Activity of Various extracts from different parts of *Cassia sophera* Linn

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### Abstract

The present study deals with the preliminary phytochemical screening and determination of antibacterial activity of various extracts from different parts of *Cassia sophera* Linn. The extracts were tested against three Gram positive and three Gram negative bacteria by the disc diffusion method at the concentration of 300 µg/disc. The results revealed the presence of phenolic compounds, flavonoids, terpenoids, alkaloids, saponins, tannins and steroids in the extracts. All the extracts exhibited antibacterial effect against the tested bacteria with the diameter of inhibition zone ranging from 9.0 to 19.5 mm, however, highest antibacterial activity was observed by chloroform extracts. Chloroform extract of seed showed the strongest effect against *Sarcina* sp. and *Pseudomonas aeruginosa* with their zone of inhibition diameter 19.5 mm and 14.5 mm, respectively. On the other hand, chloroform extract of flower showed the strongest effect against *Sarcina* sp. (inhibition zone 18 mm) and *Pseudomonas aeruginosa* (inhibition zone 16.5 mm), while leaf extract of chloroform showed the strongest activity against *Bacillus cereus* (inhibition zone 18 mm). In some cases, the organic extracts exhibited almost similar activity compared with standard sample streptomycin. The preliminary studies on *Cassia sophera* L. extracts exhibited their anti-bacterial potential which could be exploited further as an anti-bacterial for pharmaceutical treatment, natural therapies, food preservation and cosmetic applications.

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## ***In-vitro* comparative quality evaluation of marketed Bisoprolol 5mg tablets in Bangladesh**

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### **Abstract**

Bisoprolol, a highly selective beta-1 blocker that is widely used for the treatment of chronic heart failure and hypertension. The therapeutic effects of this drug are greatly influenced by their pharmaceutical qualities and physiochemical equivalence. Therefore, the aim of this study was to assess the comparative quality and physiochemical equivalence of different brands of Bisoprolol available in Bangladeshi drug market. For this study Bisoprolol 5mg tablets of 5 different brands were purchased and coded as B1, B2, B3, B4 and B5. All the quality control parameters i.e., drug content, weight variation, thickness, hardness, diameter, friability, disintegration time and dissolution profile were studied according to pharmacopoeial specifications. Assay result revealed that the drug content of the studied brands was between 93 to 105%. Although, weight variation, diameter, thickness and friability data of all brands met the standard criteria's but the hardness and disintegration time results failed to meet the standard criteria's. Dissolution study showed that B3 was the slowest drug release brand while brands B1, B2 and B5 was almost similar in their release pattern and released 90% drug within 60 minutes. As the *in-vitro* quality control parameters have profound effects on therapeutic properties, so the manufacturer should be more conscious to maintain uniformity regarding these parameters. However, further *in-vivo* studies should be required to evaluate their therapeutic equivalence.

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## **Analytical and bioanalytical methods for drug quantification**

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### **Abstract**

Analytical and bioanalytical methods are integral part of both new and generic drug development process. Analytical methods quantify drugs which can be utilized in potency determination of active pharmaceutical ingredients, intermediates and dosage forms, impurity analysis, dissolution studies etc. Bioanalytical methods deal with quantitative determination of an analyte in a biological matrix which can be used in pharmacokinetics and pharmacodynamics (PK/PD) studies, preclinical, clinical and bioequivalence studies, *in-vitro in-vivo* correlation studies etc. In our study several analytical and bioanalytical methods have been developed and validated. Analytical methods for diazepam has been developed and validated in UV-Vis Spectroscopy with linearity range of 3.096-15.480 µg/ml, whereas analytical methods of non-pharmacopoeial dosage forms such as Aceclofenac, Sitagliptin, Trimetazidine were developed and validated utilizing HPLC with linearity range of 19.8-148.5, 18.22-273.3 and 1.86-55.76, µg/ml respectively. Several other analytical methods for azithromycin, fluconazole, sildenafil,



tadalafil, omeprazole, pantoprazole etc. have also been established for providing necessary analytical services of Pharmaceutical Industries in Bangladesh. To facilitate PK/PD and bioequivalence studies, two bioanalytical methods for quantifying Esomeprazole and Fexofenadin in human serum sample have been developed and validated using RP-HPLC with linearity range of 0.02-2.0 and 0.06-1.0 µg/ml respectively. Development of simple analytical methods utilizing the currently available technological platforms like HPLC, LC-UV and LC-Fluorescence, LC-MS, LC-MS/MS is essential for drug discovery research as well as getting safe, effective and quality medicine in local market.

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## Pharmacological and toxicological assessments of methanol extract of *Syzygium cumini* (L.) seeds in wister rats

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### Abstract

*Syzygium cumini* L. (Fam. Myrtaceae), an indigenous plant of Bangladesh, is traditionally used for the treatment of diabetes, hyperlipidemia, infertility and gastrointestinal diseases. Scientific investigations for its pharmacological activities are scarce. The present study was aimed for pharmacological and toxicological investigations of methanol extracts of *S. cumini* L. (MESC) seeds and its chloroform soluble fraction (CSF) and aqueous soluble fraction (ASF) *in vitro* and *in vivo*. The extracts were assessed for acute toxicity study in Wister rats for 14 days following OECD guidelines. Acute toxicity study of MESC (2000 and 5000 mg/kg) resulted no death and no remarkable difference on the attitude of rats in either group. Biochemical and histopathological investigations resulted no significant differences among the control and treated groups. The highest amounts of phenolic compounds were found in MESC followed by ASF and CSF (144.34 mg, 106.09 mg, and 91.28 mg of GAE /gm of extractives, respectively). The ASF exhibited the highest free radical scavenging activity (IC<sub>50</sub>: 2.91 µg/mL) which was stronger than that of Ascorbic Acid (3.05 µg/mL) and BHT (11.54 µg/mL). In hypotonic solution, the extracts exhibited mild to moderate membrane stabilizing activities: ASF 25.22%, CSF 19.73% and MSF 18.75% inhibition of haemolysis of RBC. In case of heat-induced condition, CSF exhibited strong 75.57% membrane stabilizing activity followed by MSF (59.71%) and ASF (57.21%) comparing to aspirin (0.10 mg/mL) (42.00%). The highest but moderate thrombolytic activity was exhibited by MESC (12.51%). Brine shrimp lethality bioassay showed the highest cytotoxic activity by CSF (LC<sub>50</sub>: 12.61 µg/mL). The present study demonstrated potential antioxidant, membrane stabilizing, and moderate antiplatelet and cytotoxic activities of crude extract of *Syzygium cumini* L. and its fractions. Further investigations for the isolation of its bioactive compound(s) and extensive pharmacological studies are required.

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**Day 2, 13 December 2019**

**Technical Session-3A: Science Advice in Forest Products Industries  
Organized by PPRD, BCSIR & INGS**

**Session Chair: Farid Uddin Ahmed, AF  
Venue: IFRD Auditorium**

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## Challenges in jute pulping

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### Abstract

Jute is a promising annual agricultural crop to be considered as an alternative source for pulping. In spite of considerable research on jute pulping, no progress is there to commercial exploitation of using the fibre as a pulping raw material. This is because the challenging but strategic aspects in the entire scenario in its pulping did not attract due attention. These challenging aspects include critical analysis of the supply and storage of the raw material, pulping process technology, potential of jute pulp and marketing potential of the product. The paper gives an overview on these fundamental issues.

Different types of stocks in jute, viz., stem, core, and outer bast fiber are available. The stem and the core have problems in supply, transportation and storage. Good quality pulp cannot be produced from stem and core. Consequently, the pulp from these two sources cannot compete in the market. The retted bast fibre is resistant to micro-organisms and insects, can be stored and available throughout the year. It contains low lignin and long fibres. Thus, producing pulp from retted bast fibre may be technically feasible. Pulping of the bast fibre, particularly by neutral sulfite anthraquinone (NS-AQ) process appears to be appropriate. It has the potentiality in making a wide range of paper products including value added specialty papers. In setting up a mill, prefeasibility study, pilot plant study and finally the feasibility study on pulping of retted bast fiber for making value added export quality specialty paper must conducted through an internationally recognized consulting firm. With the success of these studies, it is imperative to develop the range of paper products that can be produced from this pulp.

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## Development of sustainable plantation forestry in Bangladesh- myth or reality

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### Abstract

Plantation forestry has become a part of the overall clear felling, followed by artificial regeneration with commercially valuable tree species in the hill forests management systems since 1871 in Bangladesh. Today, the forest area has been classified as 84% natural forest (12, 04,000 ha) and 16% as plantation forests (237,000 ha). The plantation forests are composed of long rotation species (131,000 ha), short to medium rotation species (54,000 ha), mangroves (45,000 ha) and rubber plantations (8,000 ha). To mitigate the demand of timber and fuel wood in Bangladesh, a priority program of introducing fast growing tree species was taken up with *Pinus*, *Eucalyptus* and *Acacia* species to find out the very fast growing species for some difficult sites. After successive elimination, provenance, growth and yield trials, some promising species were recommended for large scale afforestation/ reforestation programs especially with an intention of rapid greening the barren hills and marginal lands. Social



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forestry concept was getting priority with the involvement of local people and appears a successful program in many areas. However, the productivity of the present planting stock in Bangladesh is extremely low in comparison to regional and international standards. There are also reports that 20-30% of all plantations established during the last 40 years have been destroyed, and of those surviving, the stocking is much less than the expected standards. The plantations appear likely to produce well below the capacity of the site due to lack of quality planting materials and proper implementation of silvicultural treatments. All this has contributed to very low growth of  $2.5 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$  in areas where  $7.5 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$  was the original standard. The paper examines the pros and cons of plantation forestry in Bangladesh and the contribution of plantation forestry for conservation of the remaining natural forests of Bangladesh.

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## **Restoration of land through multi-benefits energy crops in Bangladesh**

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### **Abstract**

Land degradation is a vital global issue affecting environment and human health. Soil contamination, waterlogging, deforestation, salinization etc. have led to land degradation in several countries including Bangladesh. Enrichment plantation and aided regeneration by plantation of indigenous native plant species is being used to help in restoration of natural forest ecosystems in the Chittagong Hill Tracts (CHTs) and sal forest areas. Many degraded sal forest areas have regenerated through coppice management in 8-10 years. Islands or patches of secondary forests appear in many private lands in the Chittagong, Sylhet and CHTs. Short-rotation species planted for fuelwood and pulp are *Acacia auriculiformis*, *A. mangium*, *Eucalyptus camaldulensis* including coastal afforestation by *Sonneratia apetala*, *Avicennia officinalis*, *Rhizophora gymnorhiza* and *Casuarina equisetifolia*. Among long-rotation species planted for industrial pulp and timber production include teak, *Dipterocarpus turbinatus*, *Swietenia macrophylla*, *Lagerstroemia speciosa*, *Cedre latoona*, *Artocarpus chaplasha*, and *Syzygium grande*. Phytoremediation can help in eco-restoration of soil along with making profit which may be pulled commercially by energy users if the government policies help to internalize its multiple ecological and socio-economic benefits like preservation of non-renewable resources and reducing green-house gas emissions. Deployment of dedicated energy plants to remediate contaminated land without impacting food security is one of the most sustainable means to restore degraded land along with carbon sequestration and energy security. Bioresources (plant) harvested from environmentally stressed agro-ecosystems have multipurpose benefits as bioenergy source, usage as natural fibres, biocomposites, paper, pulp and other uses. It is proposed that the short and long duration energy-rich plant species that can provide not only for timber and pulp but also act as phytorestorers of degraded land can be employed in Bangladesh for improving the environment, economy and energy needs of the country.

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## **Forestry and forest management in Bangladesh**

**I. U. Ahmad**

*Retired Chief Conservator of Forests Dhaka, Bangladesh and Former Country Representative of IUCN*

### **Abstract**

Out of 1.5 million ha of reserve forest land, only about half of the area is under natural forests, mostly in the Sundarbans. The rest is covered by plantations, scattered tree forests and deforested areas. About 0.2 million ha of coastal forest has been raised on the newly accreted land from the sea.

Timber and firewood harvest, expansion of agriculture and encroachment are the major drivers for both deforestation and forest degradation. Lack of proper forest management practices including poor governance triggers an over-arching impact that fuels the major drivers. However, the management scenario has become more complex as the pressure on the forests by the increasing population has increased and the impact of climate change on forests has become a reality. Industrial plantations with long rotation species were established in the reserve forests of hill districts. Plantations of fast growing species and coastal plantations were also raised. Apart from creating short rotation social forestry woodlots in denuded or encroached forest lands, the Forest Department has also been establishing large scale participatory strip plantations along road sides, on coastal embankments and along railway tracks. Co-management with the engagement of local people is protecting the ecosystem. In this system the participating people depend for their lives and livelihoods as well as protecting the forest. It is considered to be a paradigm shift in forest management. Expansion of participatory forestry in both TOF (Trees outside forestry) areas and reserve forests, delineating forest boundary, combating impacts of climate change, restoration of degraded forests, expansion of coastal forestry, etc., are some areas to address to rejuvenate forests and biodiversity of the country.

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**Technical Session-3B : Water and Environment**

**Session Chair: Prof. Kyungho Choi, SNU, South Korea  
Venue: ITTI, Room no. 611**

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## **Sustainable Comprehensive Wastewater Treatment Approach through Water Research Center, JU**

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### **Abstract**

Over the last couple of decades surface water quality especially around Dhaka city has deteriorated mostly due to unplanned conventional development. Though some of industries are started to take initiative to treat the effluent, lack of technological knowledge, high operational cost, high chemical consumption, high manpower involved, unwilling to take extra expenditure, technical fault of ETP due to poor after sales service from the suppliers, dependency on the foreign expert/technology and lack of monitoring from the authority reduce the comprehensive effectiveness of ETP operation. Water Research Center (WRC) under the Department of Environmental Sciences, Jahangirnagar University carrying out several researches regarding surface water pollution and chemical dose optimization with variable pollution loads in an ETP, development of a model ETP that combines all major process into a single one and the study on the feasibility of natural coagulants and adsorbents in bulk ETP system since 2014. This model ETP also contains waste sludge management options and aerobic alternation of three phased aeration tank. A significant number of undergraduate to doctorate level students are also doing their research here. Achievements gained by WRC so far is the development of comprehensive effluent treatment model (CETM) that minimizes the major conventional treatment disadvantages with user friendly mode at cheaper rate in present and future. Another milestone is Development of a biogas production unit from wastewater sludge. By doing these WRC already met one of the prime milestones to achieve Millennium Development Goals (MDGs) and looking forward to achieving Sustainable Development Goals (SDGs).

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## **Method Validation and Identification of Priority Pollutants in Water and Sediments of the Buriganga River, Bangladesh: An Ecological Risk Perspective**

**M. A. Akbor<sup>1,2</sup>, M. A. B. Siddique<sup>1</sup>, M. A. Ahsan<sup>1</sup>, S. Ahmed<sup>1</sup>, A. Nahar<sup>1</sup>, M. M. Hasan<sup>1</sup>, M. M. Rahman<sup>2</sup>  
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### **Abstract**

Industrial waste water either directly or because of inadequate treatment process water is loaded with higher concentrations of pollutants discharge into aquatic ecosystems. Pollutants like toxic metals and others subsequently deteriorate the water quality, environmental ecology of the Buriganga River. Therefore, in order to monitor the pollution levels, in this study water samples were collected from eight points and sediments from seven points. Organochlorine pesticides (OCPs), and polychlorinated biphenyls (PCBs) were determined by gas chromatography with electron capture detector and Polly aromatic hydrocarbons (PAHs) were determined by gas chromatography with mass detector in water and sediments samples. Metals were determined by Atomic Absorption Spectrophotometer (AAS) with flame and graphite furnace in water and sediments samples. For



sediment samples geo-accumulation index ( $I_{geo}$ ), contamination factor (CF), potential ecological risk (PER) and Risk index (RI) and pollution load index (PLI) was calculated. The  $I_{geo}$  is increased in order of  $Ag > Pb > Cu > Zn > Hg > Cd > Cr > Co > Ni > As > Se > Sb > Be > Tl$  in both seasons.

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## **Assessment of Heavy Metals Toxicity and Ecological Impact on Surface Water from Padma River**

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<sup>2</sup>*Department of Zoology, University of Rajshahi, Bangladesh*

<sup>3</sup>*Institute of Environmental Science, University of Rajshahi, Bangladesh*

### **Abstract**

The present study deals with the estimation of heavy metals in surface water collected from Padma river near Rajshahi City, Bangladesh and assessment their impacts on human and ecology by heavy metals contamination. Water sample from three locations were collected acid digested and concentrations of trace metals such as Pb, Mn, Cu, Ni, Cd, Cr, and As were determined using atomic absorption spectrophotometer (AAS). The average concentration of studied metals in water of Padma River followed the decreasing order of:  $Mn > Cr > Zn > Pb > Ni > Cd > Cu > As$ . The calculated WQI value of Padma river ranged between 30.07-35.19 and 35.86-41.84 for drinking water; 11.44 to 13.58 for irrigation and 48.85 to 56.47 for aquatic life according respectively. Most of the samples were found within the limit of standards of DoE (1997 and 2002), WHO (2011) and CCME (2007) for surface water. Human health risk assessment revealed non-carcinogenic health risk posed by the ingestion or dermal contact of heavy-metal-contaminated water is low, having overall HI value  $2.3 \times 10^{-4}$ .

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## **Residue amount determination of DDT (p,p'-DDT, p,p'-DDE, p,p'-DDD) and BHC ( $\alpha$ -BHC, $\beta$ -BHC, $\gamma$ -BHC, $\delta$ -BHC) organo chlorine pesticides in cultured and captured fish of two different region of Bangladesh**

**M. H Kabir<sup>1,\*</sup>, S Ahmed<sup>1</sup>, S. A. Tanima<sup>2</sup>, M. H. Al- Mamun<sup>2</sup>, S. Yasmin<sup>1</sup>, A. Akbar<sup>1</sup>, M. A. Al-Masur<sup>1</sup> and**

**A. H. M. S. I. M. Jamal<sup>1</sup>**

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<sup>2</sup>*Department of Fisheries, University of Dhaka. Dhaka-1000*

### **Abstract**

Residue amount of DDT (p,p'-DDT, p,p'-DDE, p,p'-DOD) and BHC ( $\alpha$ -BHC,  $\beta$ -BHC,  $\gamma$ -BHC,  $\delta$ -BHC) organo chlorine pesticides in cultured and captured fish in two different region Ramganj and Kishorganj of Bangladesh was determined. The



sample preparation was done using modified Quick Easy Cheap Rugged and Safe (QuChERS) method. The Analysis was done in GC-MS. The linearity was in the range (0.0002-0.2) mg/L and remain good with the regression coefficient ( $R^2 \geq 0.996$ ) and the recovery was in the range (77.0-98.6)%. The residue amount was determined in *Catla catla*, *Labeo calbasu* of Kishorganj, *Anabas testudineus*, *Heteropneustes* fossils from Ramganj. The residue amount of DDT in cultured fish for *Catla catla* (p,p'-DDT<LOD, p,p'-DDE=0.39, p,p'-DOD=0.11 mg/Kg), *Labeo calbasu* p,p'-DDT<LOD, p,p'-DDE=1.56, p,p'-DOD=0.35 mg/Kg), *Anabas testudineus* of p,p'-DDT<LOD, p,p'-DDE=2.33, p,p'-DOD<LOD mg/Kg), *Heteropneustes* fossils p,p'-DDT<LOD, p,p'-DDE=0.23, p,p'-DOD=0.03 mg/Kg), of BHC *Catla catla* ( $\alpha$ -BHC=1.41,  $\beta$ -BHC<LOD,  $\gamma$ -BH=34.33,  $\delta$ -BHC<LOD mg/Kg), *Labeo calbasu*  $\alpha$ -BHC=1.28,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=29.59,  $\delta$ -BHC=4.68 mg/Kg), *Anabas testudineus*  $\alpha$ -BHC=1.7,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=26.24,  $\delta$ -BHC=4.54 mg/Kg), *Heteropneustes* fossils  $\alpha$ -BHC=0.10,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=27.07,  $\delta$ -BHC<LOD mg/Kg), in captured fish for *Catla catla* (p,p'-DDT<LOD, p,p'-DDE=0.74, p,p'-DOD=0.30 mg/Kg), *Labeo calbasu* p,p'-DDT<LOD, p,p'-DDE=0.74, p,p'-DOD=1.72 mg/Kg), *Anabas testudineus* p,p'-DDT<LOD, p,p'-DDE=3.03, p,p'-DOD=0.02 mg/Kg), *Heteropneustes* fossils p,p'-DDT<LOD, p,p'-DDE=13.01, p,p'-DOD=0.68 mg/Kg), of BHC *Catla catla* ( $\alpha$ -BHC=0.41,  $\beta$ -BHC<LOD,  $\gamma$ -BH=43.05,  $\delta$ -BHC<LOD mg/Kg), *Labeo calbasu*  $\alpha$ -BHC<LOD,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=47.74,  $\delta$ -BHC<LOD mg/Kg), *Anabas testudineus*  $\alpha$ -BHC=1.34,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=71.48,  $\delta$ -BHC=4.81 mg/Kg), *Heteropneustes* fossils  $\alpha$ -BHC=11.43,  $\beta$ -BHC<LOD,  $\gamma$ -BHC=63.17,  $\delta$ -BHC<LOD mg/Kg). The residue amount in captured fish was higher than that of cultured fish. This may be concluded the residue amount in captured fish is higher in captured fish because these fish grown in the fellow land and water area where more pesticides used for agricultural purposes.

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## Nutritional values and environmental contaminants in fish species from Saint Martin's Island

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### Abstract

Fisheries and aquaculture sectors are vital source of tackling animal-based protein and nutrition. It has been predicted that fish consumption in developing countries will increase by 57%, from 62.7 million tons in 1997 to 98.6 million tons in 2020. Saint Martin's Island is one of the inseparable parts of tourist spots in Bangladesh economy and fish production of Saint Martin's island plays also a significant role in nutritional balance of protein. In this study, a total of 26 fish samples (13 fresh and 13 dry) was collected from Saint Martin's Island. Fish oil was extracted by solid phase dispersion method. Saponification and esterification were carried out with some simple modifications. The percentage range of moisture in each fresh fish was found to be ranging from 75.70% (Takchanda) to 88% (DatinaKoral) whereas in dry fishes it was ranging from 30.61% (Rup Chanda) to 37.86% (BolKoral). The percentage of ash was higher in dry fishes ranging from 16.89% to 26.33% whereas it ranged from only 0.3% to 2.91% in fresh fishes which were determined according to standard AOAC (2000) method. Fatty acids (Lauric acid, myristic acid, palmitic acid, and stearic acid) were predominant which were analysed by GC-FID. Among the unsaturated fatty acids, mono-unsaturated oleic acid, palmitoleic acid were also found. Palmitic acid was in the range of 41.33-60.89% in fresh fishes and 41.13-63.37% in dry fishes. All fresh fish samples contained rich amount of protein. Flying Fish possessed the highest amount of protein (75.90%) whereas DatinaKoral contained the least amount of protein (40.51%). Heavy metals were





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determined by using atomic absorption spectrometer (AAS). The range of Cr, Cd, As, Pb, Cu, Zn, Fe were  $0.00-23.68 \times 10^{-3}$ ,  $0.00-4.08 \times 10^{-3}$ ,  $0.00-1.70 \times 10^{-3}$ ,  $0.00-133.07 \times 10^{-3}$ , 0.43-8.42, 1.22-2.48, 0.00-4.28 mg/kg in fresh fish samples and  $0.00-18.08 \times 10^{-3}$ ,  $0.00-0.71 \times 10^{-3}$ ,  $0.00-8.39 \times 10^{-3}$ ,  $0.00-176.90 \times 10^{-3}$ , 0.12-2.90, 0.00-2.46, 0.64-10.84 mg/kg in dry fish samples respectively.

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## **Removal of Arsenic from Water and waste water Using Graphene-based Nanoadsorbent**

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### **Abstract**

Arsenic is highly toxic and is widely present in the environment through mining activities, leaching from soils, fertilizers, industrial wastes, biological activity, and naturally occurring As containing minerals. Long term exposure to trace levels of As (i.e. inhalation, ingestion) may lead to several chronic effects including skin, cardiovascular and respiratory diseases. The use of two-dimensional graphene-based materials have attracted widespread attentions as novel adsorbents for the adsorption of various water pollutants in water treatment due to their unique physicochemical properties such as, high surface area, high mechanical strength, excellent corrosion resistance and tunable surface chemistry. In this report we have synthesized graphene based nanoadsorbent by using simple hydrothermal method. Scanning electron microscopy (SEM), Electron Dispersive Spectroscopy (EDS) and X-ray diffraction (XRD) were employed to characterize the as prepared composite. The arsenic adsorption behavior of the graphene based adsorbent was investigated in terms of contact time, pH, and adsorbent doses. The graphene based nanoadsorbent exhibited significant, fast adsorption of arsenic over a wide range of solution pHs with exceptional durability and selectivity, which could make this nanoadsorbent a very promising candidate for effective removal of arsenic from water and waste water.

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**Technical Session-3C: Materials and Metallurgy-Light Engineering**

**Session Chair: Prof. Fahmida Gulshan, BUET  
Venue: ITTI, Room no. 612**

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## Foundry industry in Bangladesh - some observations

A. S. W. Kurny

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### Abstract

The prevailing condition in the foundry industries sector in Bangladesh has been outlined. The impediments to the growth of the foundry industries have been listed. Examples of plausible changes in materials and technology have been put forward. Recommendations on pricing of foundry products for consumption at home, supply of appropriate raw materials to the foundry industries and on possible export of Bangladesh foundry products have been made.

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## Structural integrity assessment of engineering components

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### Abstract

It is now well accepted that engineering components may contain flaws or defects from their very outset. It is also well established that microstructural damage may evolve during the service life-time of components leading to creation of defects. In structural integrity assessment, the acceptability of such flaws and defects can be evaluated quantitatively in order to determine the whether such components can be continued in service or if there is an imminent need for repair and replacement.

Structural integrity assessment involves characterization of material microstructures, determination of their mechanical properties, non-destructive evaluation of in-service components and analysis of the stresses and service conditions that such components are subjected to various codes and protocols have been developed for assessment to determine the fitness-for-service of engineering components. Many of these recognize diverse damaging mechanisms, such as fatigue, creep, corrosion, wear, etc. in their formulations to predict the integrity status of components. Some of the protocols are based on the application of fracture mechanics principles to treat the stability of the cracks formed by the damaging processes. The knowledge, infrastructure and expertise involved in assessment of structural integrity can also be used for remaining life assessment and analysis and investigation of industrial engineering failures.

The talk will present an overview of the practice of structural integrity assessment, the background knowledge of material microstructures, deformation behaviour and fracture mechanics involved, and the infrastructure and expertise that have to be developed.

The generation of microstructural and fracture mechanics based mechanical properties data for a copper-strengthened high strength low alloy (HSLA) steel employed for naval structural application will be exemplified as part of the scope of work to



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be carried out structural integrity application. A few cases of analysis of engineering component failures will be highlighted to elucidate the importance of non-destructive testing and microstructural analysis in the process. The importance of understanding the service conditions of engineering components, including the stresses that they are subjected to will be emphasized.

The status of expertise in the practice of remaining life assessment, structural integrity assessment and failure analysis at CSIR-NML will be presented, including details of the equipment and facilities that are required.

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## **Effect of Bismuth (Bi) Addition on the Thermal and Mechanical Properties of Environment Friendly Lead Free Sn-Zn Solder Alloy**

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### **Abstract**

Sn-37Pb solder alloy has been used traditionally in electronic and opto-electronic packaging due to their low melting temperature and good soldering properties and low cost. However, Lead (Pb) is a hazardous element for human health and the environment due to its toxicity. After approving Waste Electronic and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) European Union countries banned using lead and lead alloys in soldering purpose. The USA, the EU and Japan forbade the use of Lead containing products. Since then Sn-9Zn eutectic alloy has been recognized as a possible replacement of Pb solder because of its better mechanical properties and lower melting points. This study investigates the effect of Bismuth (Bi) content on the microstructure, thermal and mechanical properties of the eutectic Sn-9Zn alloy. Different quantities of Bismuth (Bi) were added ( $x = 0.5, 1, 2, 3$ , wt %) to study the characteristics of Sn-9Zn-xBi ternary alloys. Differential Thermal Analysis (DTA) and Thermo-mechanical Analysis (TMA) were carried out to obtain thermal properties. Energy Dispersive X-ray Fluorescence determined the compositions and tensile test was performed for measuring strength and elongation of the alloys. Optical Microscopy and X-ray Diffraction were used to study microstructures and phase constituents of the developed alloys, respectively. The results indicated that addition of Bi decreased the melting point and heat of fusion of the solders. The co-efficient of thermal expansion also increased after Bismuth (Bi) addition. After alloying with Bismuth (Bi), the SnBi inter-metallic compound (IMC) precipitates were formed and they extracted from the  $\beta$ -Sn matrix with non-uniform microstructure. Addition of Bismuth (Bi) enhanced tensile properties of the developed alloys than Sn-9Zn eutectic alloy but higher amount of addition reduced it eventually.

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## **Fabrication and characterization of Ni-Foam**

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Metallic foams are used extensively in many engineering application due to their low density, moderate mechanical, thermal and acoustic properties. It can be used for proton exchange membrane (PEMFC) of the battery producing bipolar plate material modification, solid oxide fuel cell (SOFC) of the relay feeder, electrolysis electrode materials (such as in water electrolyses environment). Nickel foam was fabricated by powder metallurgical process. Ammonium Hydrogen Carbonate was used as foaming agent. The sintering was done at 1400°C for 2 hrs. Foaming agent usage varied from 25-45%. Density, compressive strength, porosity were measured for different foaming agent addition which showed remarkable variations. XRD, XRF and SEM-EDS analysis confirmed pure Ni in the samples. SEM showed porous structure of the Ni foam.

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## **Fabrication of NiTi Alloy Foam and Characterization**

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<sup>2</sup>*PP & PDC, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205*

### **Abstract**

NiTi foam is a shape memory alloy used as biomaterial. In this paper, the fabrication of open cellular NiTi alloy foams from elemental nickel and titanium powder. Current space holders used to fabricate titanium foam have drawn attention to issues such as solubility, removal time, expensiveness and lack of environmental friendliness.  $\text{NH}_4\text{HCO}_3$  has been utilized in this research to overcome these issues.  $\text{NH}_4\text{HCO}_3$  is chemically stable, insoluble in both titanium and nickel and can be burnt off easily by heating. The mechanical properties and pore structures were investigated by UTM and SEM, respectively. The density of the finished foam varied from 3.26 g/cc to 4.2 g/cc and the porosity varied from 34% to 49% with the increase of space holder. The compressive strength was varied from 13.78 Mpa to 66.4 Mpa and elastic modulus varied from 175.2 MPa to 768 MPa with the decrease of space holder. So, it was observed that the more the space holder the more the porosity and the less the compressive stress. XRD and EDS analysis were also done.

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## **Fe<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub> based polystyrene nano composites-fabrication and characterization**

**M. T. Islam<sup>1\*</sup>, M. A Gafur<sup>2</sup>, G. T. Rahman<sup>1</sup>, D. Islam<sup>2</sup> and Md. A. Hoque<sup>1</sup>**

<sup>1</sup>*Dept. Of Materials Science and Engineering, RU, Rajshahi, Bangladesh*

<sup>2</sup>*BCSIR, Dhaka, Bangladesh*

### **Abstract**

In this work, both Fe<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub> nanoparticles were synthesized using convenient sol-gel method. Formation of nanoparticles with an average size of 40nm for Fe<sub>2</sub>O<sub>3</sub> and 35nm for TiO<sub>2</sub> respectively was confirmed by SEM, EDX and FTIR. Some agglomeration of the nanoparticles was visible on SEM image. Fe<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub> based polystyrene nano composites were fabricated using extrusion molding method. Then tensile, flexural and hardness properties were measured. Hardness increases with addition for both the nanoparticles, but tensile strength and flexural strength decreases with the addition of both of them.

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**Technical Session-3D: Food Technology, Nutrition & Food Safety**

**Session Chair: Dr. Mamtaz Dawlatana, Editor, BJSIR  
Venue: ITTI, Room no. 411**

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## **Food functionality of popular and commonly consumed vegetables and fruits from Bangladesh**

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### **Abstract**

Functional food can be either natural or processed. Food contains known biologically active compounds, which provides clinically proven and documented health benefit. So far, little is known about the food functionality of the popularly consumed vegetables and fruits of Bangladesh. As a primary step, this study has been conducted with an aim to identify and characterize functionalities of the Bangladeshi fruits and vegetables. Common seasonal fruits and vegetables, which are very popular for their taste, price and easy availability, have been selected for in vitro screening of their functionalities. All vegetables samples have shown appreciable anti-oxidant values in general. Water spinach & egg plants, both types (green and purple) showed maximum anti-oxidant activity. All vegetables showed anti-mutagenic activity to some extent with red amaranth maximum (~70%). Red amaranth, water spinach and egg plant (both purple and green) were found to show maximum anti-tumor activity. High levels of fat and sugar binding capacity were observed in Pineapple (500% and 270.891% respectively). High nuplli mortality rate was found in cytotoxicity test with Pomelo extract (100%), which also contained high level of vitamin C (155 mg/100g). Pomelo contained the highest level of antioxidant among all these foods (0.674 nMol/100µl/mg protein). Red amaranth contained the highest amount of protein (4.31 g/100g). In stem amaranth, Iron level was the highest (1855.67 mg/kg). Total phenolics content of Water spinach and Stem amaranth were found higher than the other samples (59.339 and 55.728 mg GAE/g respectively). All these experiments showed these vegetables and fruits have high health impacts.

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## **Study on efficacy and safety of functional food mixture**

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### **Abstract**

Curcumin is known to possess potent anti-pain properties. The aim of this study was to assess the efficacy and safety of curcumin as a functional food mixture (Karkuma) in combination with essential oils of turmeric, ginger, black pepper, mulberry fruits and multi-floral honey in arthritis patients with chronic pain. A total number of 30 patients were selected for this preliminary study and randomly selected into two groups by their age and sex match. Each group was 15 individual. All subjects in the treatment group were taken 15-20 ml mixtures twice daily up to 3 months. In addition they were take only single drug or not. In the control group all subjects were taken no mixtures and they took self-imposed medicated only single or no drug. Animal study for toxicity and heavy metal and aflatoxins test were conducted in a government research laboratory in Bangladesh. In case group, all the patients are fall moderate to severe pain scale and after three months intervention with Karkuma, none of them were found in severe pain and almost 93% had no pain or mild pain. On the other hand, in control group





no significant decrease in pain scale after three months control trial. No toxic ingredients were found in that function food mixture and heavy metal/aflatoxin level were within limit. Three months use of curcumin mixture (Karkuma) reduces pain-related symptoms in patients with chronic pain. The formulated functional food mixture (Karkuma) is safe for human consumption.

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## **Occurrence of heavy metals in muscle, egg and different organs of chicken in Bangladesh**

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### **Abstract**

Heavy metals, specially lead (Pb) and chromium (Cr) is a great concern in the poultry industry in Bangladesh. Lead is found to be associated with high blood pressure, brain damage, reproductive organs damage, and anemia. Chromium is also reported for association with lung and respiratory tract cancer and kidney diseases. Previous animal studies showed that heavy metals can be gradually accumulated in the body and affect some organs. However, the organ specific deposition of these two heavy metals in chicken is not studied yet. Apart from these, poultry feed are reported as a source of heavy metals in chicken in Bangladesh. But the present level of contamination is not clear. This study was carried out to know the current level of chromium and lead contamination in poultry feeds in Bangladesh and to understand the organ specific accumulation level of heavy metals in chicken. Samples of three different types of chicken with their corresponding feed were analyzed from three different places around the Dhaka city. Broiler chicken was found mostly contaminated with both lead and chromium where depositions in the liver were found so high. The maximum level of lead and chromium in chicken muscle were found 228 µg/kg and 31 µg/kg respectively and in chicken liver were found 324 µg/kg and 209 µg/kg respectively. The maximum level of lead and chromium in feed were found 365 µg/kg and 210 µg/kg respectively. The obtained results suggest a high contamination and bioaccumulation of lead and chromium in the organs of chicken which indicate a big public health concern. The regulatory authority may need to reconsider the regulation of poultry feed.

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## **Evaluation of capsaicin content, phytochemical content and antioxidant activity of different varieties of dried chilli (*Capsicum Spp.*) exist in Bangladesh**

**M. H. A. Rashid<sup>1\*</sup>, T. A. Khan<sup>2</sup>, A. T. M Abdullah<sup>2</sup>, U. K. Prodhan<sup>3</sup>, M. B. Hossain<sup>1</sup> and M. M. Rahman<sup>2</sup>**

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<sup>3</sup>*Department of Food Technology and Nutritional Science, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh*

### **Abstract**

Chillies have been used as spices, household medicine and for pain relief from the ancient time. In Bangladesh there are significant used of chilli as spices and also as culinary medicine. The aim of this study was to develop method of extraction and



quantification of medicinal bioactive compounds from chillis. Twelve distinctive Bangladeshi varieties of chillis namely; Ashari, BARI-1, Baliujhuri (Jamalpur), Balujhuri (Norshinghi), Baromashi, Bengal Hot, Bindu, Bogra Local, But, Magura, Zia Chilli and BARI cross (C0612) were selected for the study. Two different solvents (water and methanol) were used to comprehend the efficiency of extraction. Total tannin content, phenol content and antioxidant (DPPH assay) activity were determined. An in-house HPLC method was developed and validated for the determination of capsaicin and capsaicin content were determined. Eleven recognized phytochemicals were quantified using HPLC. The highest value of tanning and phenol was found in Binduchilli (7.3 mg and 35.4 mg) for water extract and in Baromashichilli (16.3 mg and 51.7 mg) for methanol extract. Bogra local variety chilli was highly active against oxidation in water extract and Balujhuri (Norshingdhi) variety was in methanol extract. The BARI cross C0612 chilli was the hottest among all varieties and contained 329.2 mg capsaicin per 100 g sample. Among eleven phytochemical, rutin hydrate was present in almost all sample and highest amount was in Butchilli (73.8 mg) for water extract and Balujhuri (Norshingdhi) (57.6 mg) for methanol extract per 100 g sample. The developed method was produced reproducible data. Therefore this method can be recommended for as a quality testing technique in the chilli spices industry in Bangladesh.

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## **Polyphenolic compounds profiling of *Piper chaba* and its effect on raw meat preservation**

**T. T. Dipti<sup>1\*</sup>, M. M. Rahman<sup>2</sup>, A. T. M. Abdullah<sup>2</sup>, M. R. Karim<sup>2</sup> and T. A. Khan<sup>2</sup>**

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### **Abstract**

Bangladesh is a great repository of spices belonging to various families. Spices are not only known for imparting flavors in foods but also for medicinal uses. Some spices also have the capacity of prolonging the shelf life of raw meat by inhibiting lipid oxidation and enzymatic degradation. One such regional spice is *Piper chaba* in the Piperaceae family, native to south and south-east Asia and locally known as Chui jhal in Bangladesh. Though species of Piperaceae are well investigated but little attention is given to this particular herbaceous plant. Therefore present study has been conducted to extract the phytochemicals (through different solvents i.e ethanol and methanol) and identify, quantify specific polyphenols through HPLC (High Performance Liquid Chromatography) present in *Piper chaba* stems. Study also aims to evaluate the bioactivity (antioxidant activity) and to test the effects of ethanolic extract in raw meat products preservation. According to phytochemical tests ethanolic extract has higher amount of flavonoid, tannin, phenol and overall antioxidant contents than methanolic extract. HPLC reveals that quercetin hydrate, rutin hydrate, tannic acid, syringic acid and chlorogenic acid are present in high amount in ethanolic extract, where methanolic extract is abundant in vanillin, catechin hydrate and caffeic acid. Moreover ethanolic extract showed greater free radical scavenging activity in DPPH assay with IC<sub>50</sub> value of 234.23 µg/ml. During storage period, raw meat products with ethanolic extract showed higher oxidative stability, antioxidant contents and lower fat degradability when compared to the products with no extract. So, our findings report that *Piper chaba* stem extracts contain noticeable amount of phytochemicals, polyphenols that contribute to its bioactivity and its ethanolic extract has capacity to prevent raw meat deterioration.

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## Detection of aflatoxin M1 contamination in raw milk and processed milk samples by ELISA

N. Tarannum\*, M. N. Nipa, S. Das and S. Parveen

*Food Microbiology Section, Institute of Food Science and Technology (IFST), BCSIR, Dhaka-1205, Bangladesh*

### Abstract

The presence of Aflatoxin M1 (AFM1) contamination in raw milk and processed milk samples which were collected from different sites of Bangladesh was investigated by using competitive enzyme linked immunosorbent assay (ELISA) technique. In this regard, around 70 raw milk and processed milk samples had been collected from different local markets of Bangladesh and after the investigation, it had been found that among 55 raw milk samples, 67% samples were contaminated with various levels of AFM1 ranging from 18.11 to 1137.38 ng/kg. The concentration of AFM1 in 46% of raw milk samples was higher than the maximum tolerance limit accepted by the European Union regulations (50 ng/kg) and 35% higher than the maximum tolerance limit accepted by the US regulations (500 ng/kg). Besides, among 10 pasteurized milk samples, 100% samples were contaminated with various levels of AFM1 ranging from 750.37 to 1489.28 ng/kg. So, the maximum tolerance limit accepted by both the European union (50 ng/kg) and the US regulation (500 ng/kg) was exceeded by 100% pasteurized milk samples. On the other hand, 20% UHT milk samples were contaminated with AFM1 where no sample exceeded EC/codex regulations. The extrapolation of AFM1 data to estimate the Aflatoxin B1 (AFB1) contamination in dairy cattle feedstuffs indicated that 40% raw milk samples, 100% pasteurized milk samples and 20% UHT milk samples exceeded the EC regulation (5 µg/kg) for AFB1 contamination. Thus, the findings will be very much useful for development of routine- monitoring surveys to minimize health hazard risk involving AFM1 and AFB1 contamination in Bangladesh in order to get high quality milk.

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**Technical Session-4A: Science Advice in Forest Products Industries**  
Organized by PPRD, BCSIR & INGS

**Session Chair: Dr. A. F. M. Akhtaruzzaman, BFRI**  
**Venue: IFRD Auditorium**

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## **Review of forest industry and wood supply development opportunities in Bangladesh**

**M. T. Konttori and H. Ahveninen\***

*Vision Hunters Ltd., Finland*

### **Abstract**

The demographic and economic development are the macro drivers of forest products demand. The forest sector of Bangladesh enjoys an extremely positive demand scenario, thanks to the very dynamic demographic and economic development. Fuelwood accounts for the most of wood harvesting and consumption. Natural forest resources are small & fragmented but the wood supply from village forests is increasing.

Paper & paperboard consumption is mostly based on imports and production from import pulp & recovered paper in Bangladeshi mills. Sawwood consumption is mostly based on local log supplies and that of wood-based panels on imports. Raw materials are imported at competitive world market prices and products are subject to import duty. The import value of forest industry raw materials & products amounts nowadays to some USD 1400 million/a, increasing annually.

Delta 2100 Plan recommends the intensification of reforestation as one means improving the living conditions across Bangladesh. Bangladesh has 7 distinct types of lands areas with each of them presenting different conditions & opportunities of reforestation.

Globally, plantation forests are accounting for increasing shares of industrial wood supply. Bangladesh should study at early convenience the possibilities of establishing a maximum area of high-yielding industrial forest plantations, in sustainable locations and utilizing suitable, sustainable & at districts acceptable wood species. Given the complexity of the land use conditions at districts and the broad development requirements of the forest sector (forestry and forest industry), Bangladesh may use the participatory forest sector master and cluster planning method to prepare the road map of reforestation and downstream pulpwood and log utilization. The forest sector master & cluster plan would enable the revitalization of the forest sector, resulting in a wide range of benefits at sub-district to division level and national level.

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## **Forest biodiversity of Bangladesh**

**N. A. Siddiqi**

*Former Chief Research Officer Bangladesh Forest research Institute, Chattogram*

### **Abstract**

During the past 100 years or so, there has been a drastic deterioration of forests and biodiversity in the territory now comprising Bangladesh. This report is based on literature review, collection of information from different organizations and discussion with relevant specialists. Bangladesh is represented by six natural forest types and plantations in the villages, road/embankment sides and forest land with indigenous and exotic species. There are 5,000 species of angiosperms belonging to 15% trees, 35% shrubs and 50% herbs and four gymnosperms in the natural forests. Many valuable tree species are greatly reduced in proportion, and endangered. As regards wildlife, 120 species of mammals, 700 birds, 150 reptiles and 40 amphibians



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exist in Bangladesh. In recent decades, 15 mammals, 6 birds and 2 reptilian species became extinct. Considerable numbers of wildlife species are endangered and restricted to limited areas from their former wider range of distribution.

The forest land accounts for 17% (2.56 million hectares) of Bangladesh covering hill forest, sal forest, village forest, mangrove forest and coastal plantation. Yearly wood production from government forests is low being 0.5-2.5 m<sup>3</sup>/ha. However, in homestead forests it is 7-9 m<sup>3</sup>/ha. About 70% of round wood and 80% of bamboo come from private own village grooves. The Non Wood Forest Products (NWFP) are quite diversified and includes bamboo, rattan, sungrass, nipa, hantal, patipata, mushroom, honey and wax, medicinal plants, etc. However, introduction of exotic plants, teak and rubber in particular have affected the ingenious plants and wildlife. The Protected Area covers 10.72% of total forest area. There are 17 National Parks and 20 Wildlife Sanctuaries.

Forestry sector provides significant direct and indirect employments. In 2013-14, the contribution of forestry sector to GDP was 1.63%. The contribution would be much higher if the services from forest ecosystems (in relation to storm surges, stability of environment, reduce earth quake, development of healthy microclimate, watershed management and eco-tourism) could be taken into account. Vast wetlands of the country also support a rich flora and fauna. High biodiversity is the characteristics of wetland ecosystems which have undergone degradation in many areas. The fauna, flora and the wetland need to be conserved through sustainable management. Problems, opportunities and challenges in relation to forests and biodiversity have been pin-pointed in the paper. The report presents lists of 19 on-going and 12 completed projects. Goal-oriented research studies and efficient technology transfer to the users have been suggested.

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## **Impact of livelihood improvement of forest dependent communities on forest conservation**

**F. U. Ahmed**

*Executive Director, Arannayk Foundation, Dhaka, Bangladesh*

### **Abstract**

Arannayk Foundation (AF) jointly with Bangladesh Forest Department (BFD) implemented 'Climate Resilient Participatory Afforestation and Reforestation Project (CRPARP) in nine coastal and hilly districts namely Cox's Bazar, Chittagong, Noakhali, Feni, Laxmipur, Barisal, Bhola, Patuakhali and Barguna from July 2013 to December 2016 with financial support from the Bangladesh Climate Change Resilience Fund (BCCRF). The project promoted alternative income generating activities among the forest dependent climate vulnerable resource poor communities along with their active involvement in the planning and monitoring of the afforestation and reforestation activities of the BFD. The BFD established 17,500 ha of block plantations in the degraded forest land and 2,000 km of roadside plantations with climate resilient species in the nine coastal and hilly districts. The AF selected 6,000 households from 200 villages through participatory rural appraisal method. The AF considered climate vulnerability and risk of anthropogenic disturbances to the plantations for selection of villages. For selection of participants, the AF considered proximity to proposed afforestation/reforestation sites, proximity to natural forests, vulnerability to climate change impacts and level of poverty. From each village 30 forest dependent poor households were selected through a rigorous screening process. The 6,000 selected households included 84% female headed households. The major activities included capacity development of the forest dependent communities in institutional development and



alternative income generating activities (AIGA), environmental awareness raising and promotion of improved cooking stoves and tree planting in homesteads. The AF supported the communities to establish a 'Revolving Loan Fund' for financing AIGA. In three years and a half, the average annual income of the participants increased by about 50% and their dependence on forests was reduced by 57%. Reduction in dependence of forest resources is attributed to use of improved cook-stoves, agroforestry practices in their homestead, development of entrepreneurship due to capacity building for production of specific product and empowerment of poor communities in negotiation of commodity price with market. Livelihood improvement directly contributed to reduced dependence and ultimately to the forest conservation and development of effective climate resilience.

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## **Social forestry to boost the forest based industries in India for poverty alleviation**

**S. K. Sharma**

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### **Abstract**

The National Commission on Agriculture, Government of India in 1976 introduced the concept of social forestry with an objective to increase the supply of fuel wood for domestic use, small timber for rural housing, fodder for livestock, and minor forest produce for local industries, thereby reducing the pressure on the traditional forest area. The temperate zone of the north-east Himalayas ranging in altitude from 1600 to 3500m representing one of the phytogeographical regions of India, considered well suited for implementing social forestry for planting different varieties of willow (large to small trees), namely, *Salix alba*(bis)– large tree used for making cricket bats, matchwood, tool-handles, fuel and fodder ; *Salix babylonica* (majnu) - large tree used for fodder, fuel and ornaments and *Salix daphnoides* (bhashi, bashroi)– small tree suitable for basket making, fuel, fodder. The study revealed that the willow plantation, as a part of social forestry in north-east, is a labor – intensive activity and large scale adoption of these forest based industries helped to generate income through employment and through the sale of forest based goods and services thus, enhancing their contribution to the reduction of poverty. The activity of raising willow and bamboos in their backyard and their marketing, has not only taken employment to the very door-steps of the unemployed but also contributed to the reduction of poverty in the poor areas of north-east India. Based on the outcomes of the study it is concluded that the forest sector profile is playing a key role in addressing and reducing poverty, unemployment and starvation in India.

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## **Participatory approaches in the forestry sector of Bangladesh: some reflections on the management and policy implications**

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*Shahajalal University of Science and Technology, Sylhet, Bangladesh*

### **Abstract**

Forestry sector of Bangladesh is playing significant roles in conservation and socio-economic development of the local community since time immemorial. Subsistence livelihoods to biodiversity conservation, climate change adaptation to sustainable environmental management are widely dependent on the effective management of the forest and its diverse



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resources. However, land use changes, deforestation and forest degradation, climate induced vulnerabilities and socio-political features are posing severe threat to our forestry sector individually or collectively. Various policy and program interventions have been developed and implemented to address the above mentioned circumstances, of which, participatory forestry approaches demands extra importance considering its positive influence both at community as well as national level. The history of community engagement in the forestry sector is quite old. Various participatory approaches namely agroforestry, community forestry, social forestry and co-management are at the centre stage of the forest management since early 80s.

The present paper aimed at revealing some of the salient features of the participatory forestry practices shedding light particularly on the management, livelihood and policy implications. Review of secondary articles and content analysis of the policy documents were some of the methods applied to fulfill the objectives of the study. Socio-economic and environmental contribution of participatory forestry namely social forestry has been depicted through trend analysis over a period of 15 years. In assessing the probable scopes of community based forestry in sustaining forest based enterprises such as pulp and paper based industries has also been reviewed taking Karnaphully Paper Mill (KPM) as a case example. In determining the state of the forest policy on participatory forestry context of Bangladesh, forest and environmental policies and National Development Plans (Five-year Plans) were analyzed. Based on the critical review some indications for future development have been suggested by the study keeping in mind the changing national and global scenario of the forestry sector.

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## **Climate resilient species selection and management approach for pulp wood production in the Chittagong hill tracts, Bangladesh**

**Md. K. I. Alam**

*Former Chief Research Officer Bangladesh Forest research Institute, Chattogram*

### **Abstract**

Distribution of different plant species, associations and vegetation types are likely be affected directly or indirectly by climate change. This paper discusses some of the impacts of climate change in the hill forests of Chittagong Hill Tracts (CHT), a potential area for pulpwood production in Bangladesh. It also discusses adaptation traits of plants resilient to climate vulnerabilities and management strategies for 'green technology' innovation in CHT context.

The components of climate change, concerned with respect to the hill forests of the CHT are: change in the seasonal rainfall pattern, prolonged dry periods and declined total precipitation. These will place pressure on the ecosystem services and natural range and survival of plants. Plants with thicker leaves, more efficient water-use strategies, deeper roots, rhizomes, root suckers and coppicing ability have good adaptive response to climatic changes. Coppice management along with mixed plantations with indigenous species could be one of the promising climate resilient forest management alternative in the CHT. The scientific basis for adaptation measures to ensure ecosystem services varies across major forest types. Forest management actions taken to adapt to climate change can be consistent with sustainable forest management (SFM). Gamar (*Gmelina arborea*), a potential pulpwood and timber yielding species is a widely planted and accepted by the farmers in the CHT.

The challenge of managing climate change vulnerabilities of the hill forests of Bangladesh can be met by adopting better and greater use of policy networks and better policy instruments. The paper throws some light on this strategy.

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**Technical Session-4B: Water and Environment**

**Session Chair: Md. Aminul Ahsan, BCSIR**  
**Venue: ITTI, Room no. 611**

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## Emerging chemical contaminants in the environment

M. Shoeb

*Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh*

### Abstract

Emerging contaminants can be broadly defined as any synthetic or natural origin chemicals or any microorganisms that are not commonly monitored in the environment. Emerging chemical concerns are flame retardants, pharmaceutical and personal care products, endocrine disruptors, microplastics, bisphenol A, phthalates etc. Plastic or marine debris can be harmful to wildlife and to human health, and it has the potential to transport organic and inorganic contaminants. It is estimated that approximately, 260 species are already affected by plastic debris or microplastic through entanglement or ingestion. Plastics can act as a source of environmental contaminants and contain potentially toxic chemicals including bisphenol-A, phthalate plasticizers, flame retardants etc. The overall purpose of our present work is to create awareness and remove pollution from the environment caused by plastic and other contaminants. Therefore, fish (n=30) and soil (n=30) were collected to investigate macro and micro plastic. Clean up-activities were also carried out in March 2019 and the compositions and sources of plastic wastes varying in dimensions from macroplastics to microplastics in representative terrestrial locations and waterways in Dhaka city were identified. Of nearly 90 items which were collected during cleanup, 75% to 80% were identified as plastic debris. Collected plastic litters were plastic bags (polyethylene, 45%), water and soda bottles (polyethylene terephthalate, 17%), clothing (polyesters, 11%), food and packaging containers (polystyrene/Styrofoam, 10%), water bottle lids (polypropylene, 5%) and fishing net (polyamide, 5%). These plastic debris usually enter in water bodies and pollute fish species. The dissection of the entire gastrointestinal tract of fish samples were conducted and digested by NaOH or KOH to isolate plastic litter from the organic tissue for the presence of microplastic. Suspected plastic pieces were separated from tissue residue under dissecting microscope at 10x magnification. Chemical structure of isolated plastic was confirmed by Fourier Transform Infrared Spectroscopy (FT-IR). Among all species studied Sharpunti (*Systemus sarana*) was found to be contaminated with microplastic. Suspected polymers recovered from the fish were: polyethylene, silicone rubber, and Styrofoam. The common use of such materials includes packaging, food and drink containers, insulation and industrial applications. Soil samples were screened by mechanical siever and soil with micro plastic were collected. Twenty organochlorine pesticides and heavy metals (Cd, Cr, Hg, As and Pb) were analyzed by gas chromatography coupled with electron captured detector (GC-ECD) and atomic absorption spectroscopy (AAS), respectively. Low level of pesticides and heavy metals were found in the fish species.

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## Water quality and environmental contaminants in samples from the Bay of Bengal

M. N. Islam, M. Shoeb\*, T. R. Tomal and N. Nahar

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### Abstract

The Bay of Bengal is located at the Northeastern end of the Indian Ocean and has an area of 2,172,000 km<sup>2</sup>. Several major rivers run into the Bay of Bengal. The coastal areas of Bangladesh (along the Bay of Bengal) include 60% of the Sundarbans, the mangrove forest of the Ganges/Brahmaputra delta in the west and areas with coral reefs in the Cox's Bazar provinces in the east. These areas are economically important because of fishing and biodiversity due to rich source of flora and fauna. In order to determine biodiversity, water quality parameters and environmental contaminants, 110 water samples were collected from Mongla, Kuakata sea beach and Saint Martin's Island area. pH of samples from Kuakata were ranged from 7.58 - 8.77 with an average of  $8.83 \pm 2$  which indicates lower ion presence in the water samples. Total Organic Carbon (TOC) is an indirect



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measure of organic molecules present in water bodies and measured as carbon which was analyzed for the collected samples by TOC analyzer are found in the range of 0.78 – 1.78 mg/L with an average 1.24 mg/L. Concentration of  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{3-}$  were determined by ion chromatography and only  $\text{SO}_4^{2-}$  was in a very low concentration. Dissolved oxygen (DO) and (BOD) of the water samples were determined by multi parameter analyzer. Average DO and BOD were  $8.33 \pm 1.82$  and  $0.31 \pm 0.03$  mg/L indicating that the water system were well oxygenated and good quality with low pollution. Water samples from different sources were analyzed for 5 metals such as Pd, Cd, Mn, Hg and As by Atomic Absorption Spectroscopy (AAS) and the contamination of metal elements were found in a very insignificant levels ( $\text{Pb} < 0.2$  mg/L,  $\text{Cd} < 0.01$  mg/L,  $\text{Mn} < 0.02$  mg/L,  $\text{Hg} < 0.001$  mg/L and  $\text{As} < 0.005$  mg/L).

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## Assessment of physico-chemical properties of rainfall water in Bangladesh

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### Abstract

Rainwater can be the ultimate source of potable and irrigation water. The ground water can be polluted from industrial waste and from agricultural chemicals. To use rainwater as potable and irrigation it is very urgent to monitor the physico-chemical parameter. The industrialized and populated area of Bangladesh is Dhaka, Chittagong, Rajshahi, and Khulna, from these areas rainwater sample was collected at two seasons, summer and rainy season. The observed parameter was pH, Electrical Conductivity, Acidity, Alkalinity, Hardness, Carbon dioxide, various Anions, Total Organic Carbon, Total Solids, Total Dissolved solids, Silica, and Lead. The observed pH of rainwater of summer/rainy season is 6.35/6.60, 6.5/6.80, 6.65/6.65 and 6.44/6.58 for Dhaka, Chittagong, Khulna and Rajshahi respectively. The observed Electrical Conductivity ( $\mu\text{S}/\text{cm}$ ) for summer/rainy season is 115/13, 97.5/45.6, 42.1/22.0 and 58.5/37.3 respectively. Total Dissolved Solids (mg/L) is 55/5.7, 46.2/21.3, 19.6/10.0 and 27.5/17.3 respectively. Dissolved Oxygen is 1.02/7.58, 1.84/6.75, 3.56/5.90 and 4.55/5.77 respectively. The above result showed that physico-chemical properties of rainwater in rainy season as better than that of summer season. According to the 'The Environment Conservation Rules, 1997' of Bangladesh the properties of potable water pH is 6.5-8.5, TDS is 1000mg/L, DO is 6. The observed result showed that the rain water can be used as potable water. Now we need to study to develop the process to store rain water for different purposes.

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## Monitoring of Antibiotics in Food and Environment by LC-MS/MS

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### Abstract

Food safety and quality is very important for food consumption. Food producing animals get resistance by repeated use of same antibiotics or over-use of antibiotics. Resistance may transfer from animal's meat to human through food chain. Antibiotic residue in meat may pose adverse health effects for the consumers. Amoxiciline, ciprofloxacin, enrofloxacin, tetracycline (TC), oxytetracycline (OTC) & chlortetracycline (CTC) etc are being used in broiler chicken farm in Bangladesh to protect them from various the diseases like Gumboro, Salmonellosis, Ranikhet etc. Maximum Residue Limits (MRL) for TC, OTC, CTC in



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animal origin as recommended by Bangladesh Food Safety Regulations (2017) are 200 ( $\mu\text{g}/\text{Kg}$ ) for muscles. To assess residual antibiotics in poultry meat, a reported method was followed and validated to determine the residual level of TC, OTC and CTC in broiler chicken meat samples by Liquid Chromatograph Tandem Mass Spectrometer (LC-MS/MS) coupled with Electro Spray Ionization (ESI) and Triple Quadrupole (QQQ) mass analyzer. Identification of certified standard, TC, OTC and CTC were done by Q1 and Q3 Scan of precursor ion (445, 461, and 479) and quantitation were done using calibration of product ion (410, 426, and 444) by MRM (Multi-reaction Monitoring). A total of fifteen chicken meat samples from super shop and the local markets were analysed by LC-MS/MS coupled with ESI for determination of the residual antibiotics. Extraction of poultry meat samples were carried out by Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) method and cleaned up with C-18 & primary secondary amine (PSA). Sensitivity of the LC was measured by evaluating limit of detection (LOD) and limit of quantification (LOQ) which were 0.04, 0.10 and 0.19 ng/g and 0.13, 0.31 and 0.56 ng/g, respectively for TC, OTC and CTC. The accuracy was evaluated in terms of percentage recoveries ( $n=5$ ; 3days) and precision was estimated by determining the co-efficient variances. Linear matrix matched calibration curves were obtained for TC, OTC and CTC with coefficients correlation ( $r^2$ ) 0.998, 0.995 & 0.998. Residue of these antibiotics was below MRL values in the analyzed meat samples.

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## **A comparative study on water quality both of imported brands and local brands of bottled drinking mineral water in Bangladesh**

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*Institute of National Analytical Research & Service, BCSIR, Dhaka, Bangladesh.*

### **Abstract**

The concentration of pH, TDS, EC,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{HCO}_3^-$  and metal such as Ca, Mg, Na and K were found to be 7.2, 55.36 ppm, 120.13 ppm, 0.011 ppm, 3.86 ppm, 12.18 ppm, 0.45 ppm, 45.12 ppm and 2.83 ppm, 2.75 ppm, 11.14 ppm, 0.45 ppm respectively. The concentration of As, CN, Cd, Cu, Cr, Pb, Mn, Fe, Hg,  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{Cl}_2$ , Salinity and biological (E. coli) status were pleasant label compliance with standard limits of WHO (2011), US EPA (2018), IBWA (2008), BIS (2012) and ECR (1997) drinking water guideline. It was found to be that imported brands had significantly high levels of bicarbonates and TDS (360 to 430 mg/l and 345 to 480 mg/L) compared to local brands (2.88 to 279.59 mg/l and 2.9 to 209 mg/L). Zam Zam water, Tubewell water and tapewater's bicarbonates and TDS found to be (195.4 mg/L and 845 mg/L), (296.73 mg/L and 260 mg/L) and (135 mg/L and 52.14 mg/L) respectively. Imported brands, Zam Zam water and Tubewell water also had high concentration of calcium (120 mg/l, 96 mg/L and 53.4 mg/L) and magnesium (15.1 mg/L, 38 mg/L and 32.06 mg/L) concentrations compared to local brands calcium and magnesium (2.5 mg/L and 2.4 mg/L). We found good quality of water from D1 and D8 brands and the majority of the brands tested were low in mineral contents which indicate to be as good distilled water. Most of the water producer companies do not mention exact tested value of water quality parameters on bottle packet and have no internal scaling which is supported by national and international Standard limit of drinking water guideline. Lack of law and policy of drinking water most of the company produce distilled water which is very harmful to our health.

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## **Exploring of chlorpyrifos, and diazinon mineralizing endophytic and soil bacteria associated with plant growth promotion traits to promote sustainable development**

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<sup>2</sup>*Institute of National Analytical Research and Service (INARS), BCSIR, Dhaka-1205, Bangladesh.*

### **Abstract**

To carry out these research total twenty individual bacteria were isolated from Aman rice soil, tomato root and cauliflower root and grown on pesticide (chlorpyrifos, and diazinon) containing media where pesticides were used as sole carbon source. These isolates were named as D-1 soil, D-2 soil, D-3 soil, D-4 soil, D-5 soil, CS-1 soil, CS-2 soil, CS-3 soil, CS-4 soil, CS-5 soil, D-T.R.1, D-T.R.2, D-T.R.3, CS-T.R.1, CS-T.R.2, CS-T.R.3, D-C.R.1, D-C.R.2, CS-C.R.1, and CS-C.R.2 according to their sources. The eighteen (18) isolates among 20 were characterized by 16s rRNA gene sequencing. All the isolates showed positive result on growth promoting traits experiment. The maximum Indole-3 acetic acid (IAA) production was observed in CS-T.R.3 and CS-T.R.2, maximum ACC deaminase activity in D-5 soil and CS-3 soil among 20 isolates where all the isolates showed positive result in nitrogen fixing and phosphate solubilizing test. Further confirmations of growth promotion activity, these isolates were applied on eggplant. The significant ( $p \leq 0.05$ ) result was found on CS-2 soil, CS-T.R.2, D-1 soil and D-2 soil bacteria treated eggplant in root length and shoot length elongation along with consortium treatment of bacteria had higher effect on eggplant growth. The pesticides bio-degradation was confirmed by FT-IR analysis. D-T.R.1 and D-4 soil had the high capability of degrading the P=S bond and C=C bond of diazinon respectively. CS-1 soil, CS-2 soil and CS-5 soil bacteria had the high capability of degrading the C-Cl bond and the benzene special vibration bond of chlorpyrifos. These strains have plant growth promoting traits which was examined on eggplant associated with they can degrade the pesticide residues to promote sustainable development.

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**Technical Session-4C: Materials and Metallurgy-E-Waste**

**Session Chair: Prof. Kyungho Choi, SNU, South Korea  
Venue: ITTI, Room no. 612**

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## **E-waste: Status, Prospects and Contribution of CSIR-NML, India**

**M. K. Jha**

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### **Abstract**

Improved life style, technological advancement and fast changing socio-economic pattern have led to the generation of huge amount of waste electrical and electronic equipments commonly known as e-waste. The quantity of these obsolete equipments is increasing worldwide with alarming rate due to their rudimentary disposal, improper collection system as well as lack of cost-effective technology for processing. To minimize its accumulation, developed countries are dumping their e-waste in developing countries. Due to the fast development of each sector, the India became the fifth largest generator of e-waste. These wastes contain valuable, precious, rare, rare earth as well as hazardous metals. Therefore, their proper recycling is essentially required to protect the environment from hazards and gain valuables. In India, CSIR-NML is a pioneer research laboratory for developing application oriented e-waste recycling processes, fulfilling zero waste concepts under the collaborations with national and international research institutes and industries. The present paper is focused on E-waste recycling status, prospects and CSIR-NML's contribution in this area. Various e-waste recycling processes have been developed at CSIR-NML to recover valuables using physical beneficiation/ pyro-/ hydro-/ hybrid processes. Printed circuit boards or PCBs are the essential components among almost all electronic equipments and it contained a heterogeneous mixture of organic materials, metals, glass-fiber and epoxy resins. NML has developed novel pre-treatment flow-sheets (mechanical/ organic swelling/ pyrolysis) for effective liberation of metals from waste PCBs. The beneficiated metallic concentrate was leached using suitable lixiviant to get metals in leach liquor. The obtained leach liquor was further processed using advance separation techniques (SX/IX) to get pure solution of individual metals. The obtained purified solution was then processed using solvent extraction, precipitation, cementation, crystallization or electrowinning to get pure metal salts/ metals of Cu, Ni, Pb, Sn, Al etc. Processes were also developed for the recovery of precious metals, gold, silver, platinum and palladium from different parts of PCBs viz. integrated circuit, RAM and processors. The hydrometallurgical process for extracting gold from used PCBs of mobile phones, connectors/ gold plated pins of medical equipment and telecommunication devices has been developed. Around 350 g of gold could be recovered from 1000kg of scrap PCBs, connectors, gold plated pins etc. Application oriented hydrometallurgical recycling process to recover Cu, Al, Mn, Co, Ni, Li from black cathodic material of Li-ion batteries has also been developed. Leaching, precipitation, solvent extraction and crystallization/evaporation/ electro-winning processes were used to get various salts and metals. Scrap magnets obtained from hard-disk of computers and solar panels were studied and the process flow-sheet developed to recover Nd, Sm, Co etc as salts. Process know-how to recover rare earth metals from fluorescent tubes and indium from LCD panels are also developed. The developed processes are eco-friendly, energy-saving and comply with stringent environmental regulations.

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## **E-waste: The Bangladesh scenario**

**F. Gulshan**

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### **Abstract**

E-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its part that have been discarded by the owner as waste without intention of re-use. As information technology has rapidly advanced and the volume of electronic devices markedly surged, an increasing amount of obsolete electronic devices starts to pile up at almost every



corner of the world at uneven rates. The wastes generated from these obsolete electronic devices (E- Waste) or Waste from Electrical and Electronic Equipment (WEEE) in total can contain up to 1000 toxic substances, including lead, chromium, and plastic additives. Often rich in precious metals and other reusable materials such as plastics, e-waste has been perceived as a source of additional income by more and more low-income and unemployed laborers in Bangladesh. Bangladesh is undergoing a rapid change in different sectors and due to technological innovation and development, its use in electrical and electronic media and information technology sector is increasing in fast pace. Therefore, the e-waste generation in Bangladesh is also increasing in a rapid rate. The present paper evaluates the existing data on the flow of e-wastes in Bangladesh and estimates the future trend of e-waste generation. It also investigates the resource recovery potential from locally available e-wastes.

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## **An Overview on the E-Waste researches in BCSIR**

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*Pilot Plant and Process Development Center, Bangladesh Council of Scientific and Industrial Research*

### **Abstract**

The 'information technology era' has heavily burdened the global waste stream with electronic discards and driven the scientific community towards significant efforts to find environmentally sustainable solutions of the imminent calamity. Inclusive of the worldwide trend Bangladesh is also struggling with strategic e-waste management. Scientists of BCSIR have put several common e-wastes, namely- Printed Circuit Board (PCB), Lithium- Ion battery (LIB) and Hard Disc Drive (HDD) under scientific experimentation to find suitable routes to minimize the environmental threat as well as recover value added commercial products. Shredded FR-4 type PCB was treated via hydrometallurgical processes to liberate the solder, remove the components and finally recover the embedded copper into a highly rich copper solution. The remnant glass fiber reinforced polymer composite is being experimented to separate the glass-polymer phases. Components of the Lithium Ion battery has been successfully separated and reclaimed as Lithium and Cobalt compounds via manual separation and acidic leaching followed by basic precipitation. Work has been done to reproduce the active component LiCoO<sub>2</sub> through stoichiometric sintering process. Simple manual separation of the waste computer HDDs has yielded significant amounts of reusable metallic portions of common engineering metals. Further leaching efforts of the Neodymium magnet has seen partial success to split neodymium and iron compounds.

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## **Synthesis of nanoparticles for different applications**

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### **Abstract**

Due to the large surface to volume ratio, nanoparticles (NPs) have drawn major attentions of researchers as they show remarkable properties required for different applications. For example, Zinc Oxide (ZnO) has suitable piezoelectric and pyro-electric properties for sensor applications. Silver (Ag) nano particles show antibacterial property compatible for biomaterial applications. Furthermore, HAP (hydroxyl apatite) nano particles can be used as filler material for dental application, bone implant etc. This paper covers the synthesis and characterizations of different nanoparticles like ZnO, Ag and





HAP. Successful synthesis of ZnO nanoparticles were prepared from analytical grade reagent as well as spent zinc-carbon dry cell batteries which is an E-waste. In both cases, particles less than 100nm were obtained. Ag particles are being synthesized for antibacterial applications like wound dressing. So far single-phase Ag particles have been found by sol-gel method. HAP nano powders have been prepared for implant application and slip casting of nano HAP has been made to prepare implants like eyeball. Overall, different scopes have been explored by this work for nano-material applications.

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## **Determining the effectiveness of polyaluminum chloride coagulant from scrap aluminum for the removal of textile reactive dye**

**S. A. Eti<sup>1,2\*</sup>, S. A. Hossain<sup>2</sup>, M. E. Hossain<sup>2</sup>, M. M. Islam<sup>3</sup>, S. K. Ray<sup>1</sup>, M. J. Abedin<sup>1</sup> and R. H. Bhuiyan<sup>1</sup>**

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<sup>2</sup>*Department of Soil, Water & Environment, University of Dhaka, Dhaka-1000, Bangladesh*

<sup>3</sup>*Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh*

### **Abstract**

Polyaluminum Chloride (PAC) is a highly effective coagulant which has been used extensively in recent years for the treatment of textile wastewater for their wider availability and reduction in cost. In this study, Polyaluminum Chloride (PAC) is synthesized from scrap aluminum as a raw material by reacting of  $\text{NaAlO}_2$  with  $\text{AlCl}_3$  solution. This synthesis took place at various temperatures, e.g. room temperature, 70°C and 80°C. The synthesized PAC is characterized by means of aluminum content, basicity, FTIR spectroscopy and XRD patterns. To determine and understand the coagulation behavior and the effectiveness of synthesized Polyaluminum Chloride coagulant, a study on the removal of commercially used reactive dye solution was conducted. The coagulation process based on variables such as coagulant doses e.g; 1, 2, 3, 4 and 5ml of 100mg/l PAC and time e.g; rapid mixing at 160 rpm for 2 min, slow mixing at 45 rpm for 10 min and sedimentation (settling) time for 45 min. By the using of Double Beam UV-VIS Spectrometer, upto 88 % of dye removal is achieved by treating synthesized PAC with concentration of 10 mg/l of Navacron Navy S-G reactive dye solution at the dosages of 5 ml. This result of the current study will contribute some knowledge on the use of this effective coagulant in treating textile wastewater. Further work is now underway.

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**Technical Session-4D: Food Technology, Nutrition & Food Safety**

**Session Chair: Prof. Dr. K. M. Formuzul Haque, North Pacific University of Bangladesh  
Venue: ITTI, Room no. 411**

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## **Rice based bakery product formulation for Bangladeshi population**

**H. B. Shozib\* and M. A. Siddiquee**

*Grain Quality and Nutrition (GQN) Division, Bangladesh Rice Research Institute (BRRI), Gazipur-1701, Bangladesh*

### **Abstract**

Bangladesh Rice Research Institute (BRRI) has released a total of ninety seven high-yielding varieties (HYVs), including both inbreds and hybrids by the year 2019. Since total clean rice production is satisfactory to feed more than 160 million populations with significant surplus of rice. BRRI is focusing its research interest on the grain quality and nutrition specially nutraceutical properties to reveal its aptitude to combat with fast growing non-communicable diseases such as heart disease, cancer, diabetics etc. By the course of time, Grain Quality and Nutrition (GQN) Division of BRRI has identified some promising nutraceutically enriched HYVs such as black rice, antioxidant enriched rice, low glycemic index rice (Low GI), anti-depressive alias gamma amino butyric acid (GABA) enriched rice and micronutrient enriched rice, specially zinc enriched rice (ZER). In Bangladesh, rice based processed food items are available namely flattened, popped and puffed rice to meet local demand as traditional food items. But we assume that there is a potential scope to enhance nutraceutically enriched rice based food considering malnutrition mitigation approach, school feeding program, humanitarian and emergency relief operation into account. In this study we have formulated energy dense nutraceutical enriched rice based food formulation specially cake, biscuit and cookies having energy density ranging from 5.0-5.5 per 100 g serving. Since rice based bakery products utilize lesser amount of carbohydrate (~50%) compare to traditionally consumed cooked rice so, rice based balanced and nutritious food intake may possibly reduce the per capita rice consumption gradually and will able to make sure proper nutritional supplement for malnourish population of Bangladesh. By attaining required dietary allowance, rice based food may help sustain food security in Bangladesh in a way to properly and effectively utilizing the rice grain.

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## **Quantification of bioactive compounds and In-vitro antioxidant activities of newly developed soya sweet**

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### **Abstract**

In this work, soya sweet was developed from soya bean and the bioactive compound present in the sweet was quantified by spectrophotometric and chromatographic techniques. The in-vitro antioxidant activity of the developed sweet was also tested. Total phenolics, flavonoid and tannin of the methanol crude extract were determined by spectrophotometer while the individual phenolic compounds were determined using high performance liquid chromatography (HPLC). Antioxidant and free radical scavenging activities of soya sweet was assayed by using different in-vitro models: phosphomolybdenum blue, 2, 2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid), 1, 1-Diphenyl-picryl-hydrazyl, Ferric ion reducing antioxidant power, reducing power, metal chelating activity and super oxide scavenging ability. HPLC analysis showed the presence of several phenolic compounds such as epi-catechin, p-coumaric acid and ellagic acid in soya sweet, which may contribute differentially to the antioxidant capacity. Reductive ability was also found to increase in soya sweet concentration. It was concluded that soya sweet have bioactive compounds and antioxidant activities and that the developed soya sweet might be a potential natural source for antioxidants.

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## **Carotene enriched orange flesh sweet potatoes: A nutrition sensitive functional food for vitamin A deficiency and under nutrition**

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### **Abstract**

Fruit and vegetables provide most of the 40 to 50 carotenoids found in the human diet.  $\alpha$ -carotene,  $\beta$ -carotene,  $\beta$ -cryptoxanthin, lutein, zeaxanthin, and lycopene are the most common dietary carotenoids.  $\alpha$ -carotene,  $\beta$ -carotene and  $\beta$ -cryptoxanthin are provitamin A carotenoids, which can be converted to retinol. Carotenoids are also potential antioxidant. Orange fleshed sweet potatoes (OFSPs) are rich in carotenoids, particularly  $\beta$ -carotene. The present study investigated six varieties of Orange fleshed sweet potatoes for their carotenoids content and proximate nutrients. It was resulted in up to 8299.92 $\mu$ g carotenoids per 100g edible portion fresh, which are extremely high compared to the previous varieties reported. These OFSPs also contained considerable amount of proximate nutrients. Therefore, the tested OFSPs would be a potential source to address vitamin A deficiency and undernutrition.

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## **Development and evaluation of instant noodles from foxtail millet**

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### **Abstract**

Consumption of noodles has increased dramatically due to rapid urbanization throughout the world. But the low protein content of it is a major concern for its utilization. This research was undertaken to develop instant noodles from foxtail millet (FTM) which will reduce malnutrition with commercial importance. The biochemical and functional properties of FTM noodles were determined with standard method. Organoleptic and microbiological study was also evaluated for the quality of the product by the interaction of expert councilors' and staffs. The foxtail millet flour was incorporated with wheat flour at a replacement level of 50, 40 and 30%. Results showed that 50% FTM noodles is the best quality of noodles compared to other noodles due to its flavor, taste and overall acceptability. It contained significantly higher ( $p < 0.05$ ) amount of protein (14.78%) and energy (464.62 kcal), but lower amount of carbohydrate (57.74%) than the commercial noodles. It also enriched with Ca (23.40 mg/100g) and phosphorous (695.08 mg/100g) which was significantly higher ( $p < 0.05$ ) than the commercial noodles. It has also low bulk density (0.59 g/ml) and higher water absorption capacity (197.77%) in terms of its functional characteristics. Microbiologically it is safe to consume and can be stored up to six months of storage in an ambient temperature without adding any preservatives. So, healthy food products like FTM noodles will be highly preferable to women's especially for the working mother because of its nutritive value, easy to cook, time savings and low cost comparing to other bakery products. So it could be equally consumed like the commercial noodles available in Bangladesh.

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## **Effect of germination on biochemical changes in high yielding barley (*Hordium vulgare* L.) varieties**

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<sup>2</sup>*Department of Biotechnology and Genetic Engineering, Faculty of Applied Science and Technology, Islamic University, Kushtia -7003, Bangladesh*

### **Abstract**

The effect of germination was evaluated on the nutritional properties and enzyme activities of three barley (*Hordium vulgare* L.) varieties namely BARI Barley-4, BARI Barley-5 and BARI Barley-7 produced by Bangladesh Agricultural Research Institute (BARI). The nutritional compositions and enzymatic activities ( $\alpha$ -amylase and protease) in both raw and germinated seeds were changed gradually with germination period. Protein content of germinated seeds for BB-4, BB-5 and BB-7 was recorded as 13.65%, 14.34% and 13.95% respectively. Maximum increase of protein was 20.81% for BB-5 at 48 hours of germination. Gradual decrease was observed at 72 hours of germination and maximum decrease was 7.66% for BB-5 but protein content was higher than non germinated seeds. Enzyme activity of  $\alpha$ -amylase and protease showed the results 2.20 U/g BB-5 and 1.16 U/g BB-4. Highest increase of  $\alpha$ -amylase and protease activity was found 125.53% for BB-7 and 107.55% for BB-5 at 48 hours of germination. The highest amount of total and reducing sugar was 12.58% for BB-5 and 1.97% for BB-7 respectively at 72 hours of germination. The maximum increase of total sugar was 240.00% and in reducing sugar it was 79.09% for BB-5 and BB-7 respectively. Highest calcium, phosphorus and iron contents were 39.70 (mg/100g), 273.91 (mg/100g) and 8.37 (mg/100g) for BB-4 and BB-7 respectively. The maximum increases of calcium and iron contents were 33.26% and 85.58% for BB-4 and BB-7 respectively at 48 hours of germination. Germinated barley seeds contain more protein with other easily digestible biomolecule than non germinated seeds.

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## **Growing concern for aflatoxin contamination on food safety and security, health and trade of developing nations: imperative for mitigation**

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### **Abstract**

Aflatoxins are naturally occurring toxins produced by certain fungi mostly *Aspergillus flavus* and *Aspergillus parasiticus*. The toxins occur globally, but pose high risks in tropical developing countries especially Africa and Asia where they contaminate many agricultural commodities. Aflatoxin contamination endangers the food supplies and health of both people and livestock in addition to being a barrier to growth of trade and exports. This work reviews disposing factors to aflatoxin contamination; global exposure to aflatoxin; prevalence of aflatoxin in food; effects of aflatoxin exposure to human and animal health; trade losses due to aflatoxin; agriculture, medical and trade-based prevention as well as aflatoxin mitigation in developing countries with focus in sub-Saharan Africa. The knowledge will allow development of improved management procedures, better allocation of monitoring and awareness creation efforts, adjustment of agronomic and food processing practices and appropriate regulatory procedures to ensure safety of agricultural commodities. Unless aflatoxin levels in agricultural commodities are effectively managed, efforts to achieve food security and improve health in Africa will be undermined. Also, as food trade expands globally, food structure and safety becomes a shared concern among developed and developing countries.

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**Technical Session-5A: Nanocellulose**

**Session Chair: Dr. Yongcan Jin, NFU, China  
Venue: ITTI, Room no. 611**

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## Wood pulp based optically transparent film

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<sup>2</sup>*Research Institute for Sustainable Humanosphere, Kyoto University, Japan*

### Abstract

A simple protocol has been established in facilitating the fabrication of optically transparent composites reinforced with wood pulp. The paper sheet was produced from wood pulp by a procedure similar to paper making process and the sheet was acetylated with much care to maintain a never dried state and finally impregnated with acrylic resin. Through successful exploitation of wood pulp that can be considered nanostructured fiber containing 20 nm widths, parallel oriented and unagglomerated nanofibers, we can produce flexible optically transparent film by a simple, low-energy consumption method. Nanostructured pulp is further effectual in reducing the coefficient of thermal expansion of the resin from 213 ppm/K to 11.5 ppm/K, working similar to cellulose nanofibers reinforcement. This high performance material is an ideal candidate substrate for continuous Roll to Roll processing, and could replace the costly conventional batch processes based on the glass substrates currently used. This inspiring optically transparent and extremely low thermal expansion film could be fabricated through traditional paper manufacturing process, and thus is exceedingly closer to industrial application with prospects ready to be realized.

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## Preparation of silver nanoparticles with the aid of chitin nano-crystals and sodium lignosulfonate for efficient degradation of emerging contaminants

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### Abstract

Synthesizing silver nanoparticles (Ag NPs) with small & uniform particle size is an urgent issue in the catalytic reaction for high efficiency. Chitin nano-crystals (ChNC) derived from abundant crustacean resources, as renewable and biodegradable materials, has received much attention in the research community. Sodium lignosulfonate (NaLS), a by-product of the sulfite pulping process, can be deemed as an efficient control surfactant during the fabrication of nanoparticles. The study herein is related to the preparation of catalytic nanocomposites consisting of chitin nano-crystals/ sodium lignosulfonate/ silver nanoparticles (ChNC@NaLS@AgNPs), and the aim of this study is to demonstrate a higher catalytic efficiency of ChNC@NaLS@AgNPs nanohybrids on the emerging contaminants than that of Ag NPs and ChNC@AgNPs nanocomposites, due to the smaller and narrower particle size of Ag NPs effectively regulated by ChNC (support/ carrier) and NaLS (control surfactant). The results showed that ChNC and NaLS can play synergistic roles to prepare Ag NPs with smaller size and narrower particle size distribution compared with those of the control. Meanwhile, ChNC@NaLS@AgNPs nanocomposites possessed highest catalytic performance ( $k = 20.4 \times 10^{-3}$ ) and feasible recycling performance for reduction of MB compared to those of the control catalysts based on the equivalent Ag catalyst. The research paves a way to apply crustacean wastes based nanoparticles (ChNC) and by-products from pulping process (NaLS) in the waste water treatment for high catalytic performance.

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## **Nanocellulose from agri-wastes and forest biomass for pulp and paper industry: challenges and opportunities**

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*Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202*

### **Abstract**

Nanocellulose is a natural nanomaterial extracted from lignocellulosic biomass, having the size between 1 and 100 nm. The main components of lignocellulosic biomass are cellulose, hemicellulose, lignin, and minerals. Cellulose is a linear polysaccharide with the molecular formula of  $(C_6H_{10}O_5)_n$ , containing  $\beta(1-4)$  linked D-glucose units. Cellulose is an important structural entity of primary cell wall of plants. Depolymerization of cellulose is the most important step to be nanocellulose. Lignocellulosic biomass is abundant and renewable polymer on the earth. Cotton, jute, agricultural wastes (cotton stalks, banana plant, pineapples residues, sugarcane bagasse, corn stalks, etc.) and forest biomass (softwood biomass, saw dust, etc.) are the largest source of raw materials to produce the novel material, nanocellulose. We identified the components of raw materials through qualitative tests. In the top-down approach of synthesis, the macroscale cellulosic particles are converted into nanocellulose by mechanical, chemical, or biological ways or their combinations. Acid hydrolysis method was widely applied for extracting nanocellulose (NCC), cellulose nanofibre (CNF), cellulose nanocrystals (CNC) using agri-wastes as raw materials. Nanocellulose exhibits very large surface area to volume ratio, high level of crystallinity, liquid crystalline behavior, and enhanced mechanical properties. Pulp and paper industries are the first one where the nanocellulose is being used commercially for improving the strength, printability, and barrier properties of paper. Nanocellulose also helps to reduce the weight of the paper without compromising its strength and other quality parameters. The extraction of nanocellulose from agri-wastes at laboratory-scale/pilot project of commercial one and will be added value to agricultural residues.

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## **Development of eco-friendly nano-chitosan based composite as a coating for slow released urea tablet**

**S. C. Chakraborty and Md. I. H. Mondal\***

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

Urea, relatively cheap, available and easy in transportation, is an effective synthetic fertilizer in agricultural sector which can easily supply nitrogen. But, it has low efficiency due to excessive leaching with water and surrounding environment. To reduce nitrogen losses during fertilization different material coated urea tablets were developed. These tablets are commercially available, but the studies are still growing. Most of these coating materials are synthetic polymer which often causes environmental pollution. The aim of this study is to produce an eco-friendly slow released urea tablet by coating with natural biobased polymer. Chitosan, has emerged as one of the most promising polymers for the efficient delivery of agrochemicals and micronutrients due to its properties like biocompatibility, biodegradability, high permeability, non-toxicity, low solubility and excellent film forming ability. Nano-chitosan based composite will be prepared with rice husk ash and sago starch where rice husk ash will support the urea and sago starch will be used as an adhesive. The development of slow released coated urea is a green technology that not only reduces nitrogen loss caused by volatilization and leaching, but also alters the kinetics of





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nitrogen release, which, in turn, provides controlled nutrients to plants for their metabolic growth. Besides it will reduce the hazardous emissions ( $\text{NH}_3$ ,  $\text{N}_2\text{O}$  etc.) from current fertilizer applications which will be helpful to protect our environment. Special emphasis of this review is to develop an eco-friendly coating of urea tablet as well as release experiments and mechanisms with an integrated critical analysis followed by suggestions for future research.

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## **Microplastic in treated water throughout the process of polyester yarn Dyeing**

**U. M. Takebira, Md. I. H. Mondal\* and Md. A. Habib**

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

The early growth in Bangladesh's textile sector and garments industry is generating environmental problems. The unstructured rapid growth of the industrial group, with several factories discharging large amounts of inadequately treated wastewater which has led to serious water pollution. All yarn and fabric dyeing factories release microfibres during dyeing, washing and finishing. Micro-plastics are found in aquatic environments; on the contrary, the meticulous sources of microplastic are silent. A challenging problem which arises in this domain is polyester yarn dyeing factories are releasing liquid waste that is load with varieties of harmful containing among microplastic. These dissolved solids and microplastic are damaging the surface water. The key objectives of the study are to identify the perimeter of microplastic pollutants from polyester dyeing factories. The study was designed to examine polyester yarn dyeing factories treated and untreated water throughout dyeing process. The microplastic filtration and hot needle test positive response assured microplastic in treated and untreated water. It was determined that one kilogram polyester yarn releases more than approximate 1500 microplastic. The result found 100 microfibres (approximate) per liter of treated, untreated and poorly treated wastewater. The result is a perceptive source which is a key significance in efforts to reduce microplastic pollution and environmental emission.

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**Technical Session-5B: Pulping and Bleaching-4**

**Session Chair: Prof. Hui Wu, FAFU, China  
Venue: ITTI, Room no. 612**

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## Fiber recovery technology of mow fine screen reject

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### Abstract

The treatment of fine screen reject of MOW pulping by high frequency dispergator and air floatation was studied in this paper. The results showed that high frequency dispergator treatment could remove and break up the macrostickies from the fine screen reject. For large size ( $\geq 0.8 \text{ mm}^2$ ) macrostickies, the removal rate could reach about 92.3%, while, small size ( $< 0.4 \text{ mm}^2$ ) macrostickies would be greatly increased to the extent of as high as 181.3%, and the total removal rate of macrostickies could reach 39.3%. Further, the free macrostickies could be separated from the system by subsequent floatation. The higher the floatation reject rate, the higher the removal rate of macrostickies, when the floatation reject rates were 9.1%, 22.2% and 32.7%, the removal rates of macrostickies could reach 88.5%, 89.5% and 98.2%, respectively. The large size dirt in fine screen reject could be crushed by high frequency dispergator, and the removal rate of large size dirt ( $\geq 0.1 \text{ mm}^2$ ) could reach 49.3%~50.6%. While the high frequency dispergator effect would increase the content of small size dirt ( $< 0.1 \text{ mm}^2$ ), although the increase range is less than 11.7%. Floatation had further removal effect on dirt, and there is no obvious selectivity to dirt size, The dirt removal rate is increased with the increase of floatation reject rate. When the floatation reject rates were 9.1%, 22.2% and 32.7%, the dirt removal rates were 71.3%, 77.7% and 80.8%, respectively. The high frequency dispergator had little effect on the brightness of the pulp, while it could separate the ink particles from the fiber and disperse them to a certain extent. The final ERIC removal rate could reach more than 49.3%. High frequency dispergator combined with floatation to recover MOW fine screen reject could improve paper tensile strength and bursting strength, increased by 20.2%~23.5% and 29.3%~32.3%, respectively, but the effect on tearing resistance was not obvious.

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## Effects of pretreatment in neutral sulphite anthraquinone (NS-AQ) pulping of jute caddies

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### Abstract

The effect of pretreatment of jute caddies with cold water, hot water and 1% caustic soda solution prior to neutral sulphite anthraquinone (NS-AQ) pulping was examined. The results showed that 1% caustic soda solution treated materials responded the best in NS-AQ pulping in producing bleachable grade pulp. This superior response was due to better removal of unwanted oily substances during alkali treatment compared to either cold or hot water treatment. The pulp yield of jute caddies was higher than hardwood species widely used in pulp and paper mills of Bangladesh. The physical strength properties of the pulp like tear, tensile and burst indices were evaluated. Caddies pulp is superior to the jute stem and stick pulp but inferior to the bast fibre. Considering pulp yield and quality, NS-AQ pulp of jute caddies could be blended with imported softwood pulp for making moderate quality writing, printing and wrapping paper.

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## Directly fractionation of lignocellulosic biomass into value-added aromatic monomers and carbohydrates pulp by two-step oxidation with molecular oxygen

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### Abstract

Widely distributed and naturally abundant lignocellulose has been recognized as a sustainable feedstock for the manufacture of energy, bio-fuels, and high-valued chemicals. In an optimized bio-refinery, the various fractions of lignocellulose can be separated and then be upgraded to valuable products. Through oxygen delignification process, the lignin fractions can be effectively solubilized from lignocellulosic biomass without significant loss of carbohydrates (e.g. cellulose). However, owing to the rigid structure and the irreversible condensations, the solubilized lignin is mainly present as large molecular weight fragments and difficult to be further degraded to aromatic monomers. In this study, we reported a two-step oxidation strategy to directly depolymerize the lignin fractions in lignocellulosic biomass to aromatic monomers, with leaving carbohydrates pulp as a solid residue. Firstly, the active C $\alpha$ -OH groups in lignin were oxidized to stable C $\alpha$ =O by TEMPO (2,2,6,6-Tetramethyl-1-piperidinyloxy) in acetonitrile at low temperature (65°C). Then the pre-oxidized hardwood powders were cooking with active oxygen at 150°C in methanol/water mixture system. As a result, 95.9 wt.% of lignin in lignocellulosic biomass was solubilized, and yielding 29.4 wt.% monomeric chemicals. Simultaneously, 51 wt.% carbohydrates pulp was remained, which mainly consist of 3.8 wt.% lignin, 50.9 wt.% cellulose, and 14.1 wt.% hemicellulose. Our strategy offers a possibility for the efficient utilization of whole biomass.

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## Elemental chlorine free bleaching crops residues pulp

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### Abstract

Elemental chlorine free (ECF) bleaching of wheat straw and eggplant stalks unbleached and oxygen delignified pulps was carried out in low (70°C) and high temperature (85°C) in D<sub>0</sub> stage of bleaching. Kappa factor was optimized in each pulp to get the desired optical properties with judicious use of bleaching chemicals. High temperature (85°C) ClO<sub>2</sub> delignification was shown to be an efficient in reducing DE kappa number over conventional D stage performed at temperature 70°C. Eggplant oxygen delignified pulp saved 25% ClO<sub>2</sub> to reach 80% brightness while wheat straw oxygen pulp saved 50% ClO<sub>2</sub> in D<sub>0</sub> stage to reach 90% brightness at the same time COD load decreased significantly. But the pulp viscosity at high temperature dropped slightly.

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## Modification of technical lignin to produce artificial humic substance and organic mix fertilizer

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### Abstract

Due to the ever-increasing population growth, there is an urgent need for the development of sustainable technologies and products that can address the imbalance between the availability of arable land and growing food needs. In this context, increasing crop productivity in a cost-efficient and the environmentally-friendly way becomes a high priority. The objective of this study was to provide evidence for the opportunity to develop novel, biodegradable and highly-efficient organic fertilizers from renewable and low-cost resources such as technical lignins as well as to observe the reaction parameters to the final modified products. The raw material for the proposed process, lignin, is a low-cost and underutilized biomass by-product from pulp and paper manufacturing that is currently burnt as an inexpensive energy source. Potential benefits from the replacement of inorganic N/P/K fertilizers with lignin-derived organic fertilizers include lower production costs, carbon sequestration in soil with improved soil quality, reduced carbon footprint and greenhouse gas emissions. Technical lignins including sulfite lignin (lignosulfonate) and kraft lignin were oxidized through partial wet oxidation in alkaline conditions to obtain humic-like substances that have fertilizing properties. The partial wet oxidation makes use of relatively inexpensive oxidizing agents such as air and oxygen. The oxidation of the lignin hydroxyl groups was studied at variable lignin concentrations (15-40 wt%), reaction temperature (180-210°C) and pressure (290-435 psi) conditions. The extent of oxidation was confirmed by the increased amount of oxygen and carboxylic groups in lignin. Evaluation of the lignin biofertilizer on plant productivity was carried out by measuring the weight of the plant seedlings (leaves) from *Zea mays* (maize) and their chlorophyll content obtained under controlled growth over 40 days. The dry weight and the chlorophyll content of plants grown in presence of biofertilizer were respectively 30% and 20% higher than that of a commercially available organic fertilizer, and 137% and 52% higher than a control without fertilizer. These results demonstrate the positive effect of lignin-derived organic fertilizer as a plant growth stimulator. Another parallel experiment was conducted with kraft lignin to observe the relation of temperature, pressure and time during oxidation as well as the effect on plants of the modified samples. Further work is underway to study the relationship between properties of oxidized lignins and their performance as organic crop fertilizers.

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**Technical Session-5C: Materials and Metallurgy-Nano-Materials**

**Session Chair: Prof. Ahmed Sharif, Dept. of MME, BUET  
Venue: IFRD Auditorium**

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## Magnetism, crystallization kinetics with isothermal annealing of amorphous, nanocrystalline and nanomagnetic materials research and their applications

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*Department of Physics, Khulna University of Engineering & Technology, Khulna – 9203, Bangladesh*

### Abstract

The metalloids Si and B in the multi-spun Fe-M-B-Si (M = Co & Ni) and Fe-Cu-M-Si-B (M = Co, Cr, W, Mo etc.) alloys play a major role in their crystallization and soft magnetic behavior. The samples are initially prepared from high purity in gradients in the amorphous state in the form of thin ribbons by rapid quenching technique and subsequently annealed in a controlled way in the temperature range of 450 - 800°C for constant time. The characteristic behavior are also studied by XRD, DTA. Magnetic properties are also measured by VSM, SQUID and LCR meter. The amorphous nature of sample is confirmed by XRD and the kinetics of glass formation and crystallization as affected by a slight change in composition is studied by DTA. Thermodynamics of the amorphous and nanocrystal ribbons in respect of the formation of glassy state and its stability is affected by annealing as well as complexity of the composition. The kinetics of primary crystallization  $\alpha$ -Fe(Si) phase and secondary crystallization boride phase in composition is studied as affected DTA experiment obtained data activation energy. The nanocrystalline state is evaluated by XRD and the optimized annealing condition the grain size obtained in the range of 9 - 50nm. The primary crystallization phase shifts to higher annealed temperature implying the enhancement of thermal stability of the amorphous alloys against crystallization due to composition change. The measurements are of field and temperature dependence magnetization by VSM or SQUID. These are accounts for reduction of magnetization of all the amorphous or nanocrystalline ribbons with increasing metalloid content. The temperature dependence of magnetization, of amorphous system decreases faster with increasing temperature as compared to crystalline materials. The dynamic characteristic such as the real and imaginary such as the real and imaginary components of the complex permeability in ac conditions measured as a function of frequency of the instantaneous value of a sine wave core current density by means of an adapted LCR bridge method. Initial permeability, frequency dependence of complex permeability and relative quality factor measured in the frequency range 1kHz to 13MHz for all the different compositions and for annealing effect of initial permeability. Initial permeability strongly depends on the annealing temperature, which sharply increase nanocrystalline phase. The increase of Curie temperature during the annealing of the amorphous precursor at a temperature well below the initial of crystallization is caused by the irreversible relaxation of microstructural quantities like long range internal stress topological and chemical short range order. These are results outstanding soft magnetic properties of the studied samples are achieved due to averaging out of the magnetic anisotropy energy by exchange interaction between nanograins with appropriate volume fraction transmitted through thin intergranular amorphous layer. Realization of these exciting potentials application are require development of high permeability, large saturation and remanent induction, low loss and hysteresis and eddy current for soft magnets of operating at high temperature, high energy product permanent magnets capable and improvement mechanical properties and corrosion resistance at operating at high temperature. Nanocrystalline materials have no microstructural discontinuities such as dislocations, grain boundaries or precipitates and significant reduce the possible spinning sites for domain walls reducing coercivity and also developed new magnetic device geometries which exploit the nonmagnetic materials.

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## Magnetic nano-materials functioning in reducing eddy current losses

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Magnetic nano-materials display unusual physical properties, as compared to their bulk materials, because of their small size or large specific surface area and their technological applications in various fields. Due to their combined excellent electrical, magnetic and chemical properties such as significant magnetic saturation, high electrical resistivity, low electrical losses and very good chemical stability, they take the advantage of various diversified fields. Impedance spectroscopy is a nondestructive technique that efficiently separates various sources of resistance like grain, grain boundary and electrode etc. for nano-crystalline materials as well. In this presentation an attempt has been taken to characterize electrical properties and analyze them to compare with bulk counterpart. A possible correlation among size, resistance and applications are discussed based on the existing theories.

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## Investigation of structural, electrical, magnetic and optical properties of pure and Aluminum doped Barium Titanate

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### Abstract

Pure and Aluminum(Al)-doped Barium Titanate (BaTiO<sub>3</sub>) perovskite with the general formula Ba<sub>1-x</sub>Al<sub>x</sub>TiO<sub>3</sub> (where x=0.00, 0.01, 0.02, 0.03, 0.04, 0.05) were synthesized by the standard solid state reaction method. The samples were sintered at 13000C for 3 hours and characterized by X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Energy dispersive X-ray spectroscopy (EDX), Vibrating Sample Magnetometry (VSM) and Ultraviolet-Visible Spectroscopy (UV-Vis). XRD patterns confirmed the tetragonal structure of the prepared samples and their crystallite sizes were estimated to be in the range of 14 to 21 nm. SEM micrographs revealed that the samples possess fine grain structure with an average grain size 0.89 μm for pure sample and a maximum average grain size 2.22 μm for sample doped with an intermediate Al( x = 0.03) concentration. The EDX investigation revealed the presence of Al. The Curie temperature, T<sub>c</sub> of pure BaTiO<sub>3</sub> was found 110°C which increases with the increase of doping concentration upto x=0.04 but it decreases with further doping. The optical band gap(E<sub>g</sub>) estimated from UV-Vis transmission data were found to be in the range 2.9-3.12eV and showed an increasing trend with the increase of doping concentration upto x=0.03 (E<sub>g</sub>~3.12 eV) and decreases (E<sub>g</sub>~2.96eV) for doping further. The ferroelectric hysteresis loops were measured at room temperature for various applied 84.38 magnetic fields by VSM. The maximum value of saturation magnetization was found to be emu/g and coercivity 2306 Hc(Oe) for x= 0.03 at applied field 10 KOe. The measured magnetic properties reveal that Al-doped BaTiO<sub>3</sub> ceramics are hard magnetic material and may be integrated for suitable device applications.

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## **Effect of sintering temperature on structural, magnetic and dielectric properties of Ni-Mn-Zn ferrites**

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### **Abstract**

Spinel ferrite  $\text{Ni}_{0.8}\text{MnZn}_{0.2}\text{Fe}_2\text{O}_4$  was synthesized through a conventional ceramic technique. The prepared samples were sintered at different temperatures (1050°C, 1100°C and 1150°C) for 4 h. The structure and morphology of the samples were characterised by X-ray diffraction and Scanning Electron Microscopy. The XRD analysis confirmed the single-phase cubic spinel structure of the prepared samples and the grain size remained within the range of 299 nm to 1.083  $\mu\text{m}$ . The micrographs showed that the grain size increased with increasing sintering temperature while the porosity decreased. DC electrical resistivity exhibited excellent semiconducting behaviour of the samples. The resistivity well obeys the Arrhenius law and the activation energies are calculated from the slope of electrical resistivity plots. The Curie temperature of the samples decreased, whereas the activation energy was increased with the increase in sintering temperature. Frequency dependent (100 Hz to 1MHz) dielectric properties of the samples such as dielectric constant, conductivity, quality factor and dielectric loss tangent were also investigated at various sintering temperatures. Our research demonstrates a reasonably good result for high-frequency applications.

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## **A short presentation on research with nanoparticles**

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### **Abstract**

Particles having at least one dimension between 1 and 100 nm are called nanoparticles (NPs). NPs can be of different dimensions like 0D, 1D, 2D and 3D with various geometries such as spherical, cubic, rod, tube, sheet, flake etc. NPs can be classified as metals (Ag, Cu), metal oxides ( $\text{ZnO}$ ,  $\text{CeO}_2$ ), non-metals (carbon nanotube (CNT)), hydride and others. NPs exhibit various size dependent special properties due to their high surface area to volume ratios. For instance, enhanced catalytic activity is observed due to higher surface areas of  $\text{CeO}_2$  NPs, and antibacterial activity of AgNPs. Further, NPs have good dispersions in base fluids. Because of such properties NPs are useful materials and drawing attention to researchers to be considered as present and future nanotechnology. Generally, to prepare NPs, two approaches of Bottom-up and Top-down are used. Bottom-up techniques are preferred because the size of the NPs can be tailored with the possibilities of giving definite shapes. There are three processes for NPs synthesis such as Physical, Chemical and Biological. Among them, chemical method is enormously studied because of many advances including short reaction time and high precursor to product ratios. Some methods used in chemical processes for NP synthesis is hydrothermal, solvothermal, sol-gel, chemical reduction, supercritical fluids, precipitation etc. NPs characterizing techniques are ultraviolet-visible (UV-vis) spectroscopy, X-ray diffraction (XRD), field emission scanning microscopy (FESEM), energy dispersive X-ray (EDX) spectroscopy, transform electron microscopy (TEM), Fourier transform infrared (FTIR), thermogravimetry (TG) and X-ray photo electro spectroscopy (XPS) analyses etc. Surface phenomenon is very important when we think of NPs. Generally, NPs have very high surface energy and tends to aggregate. By doing some engineering and applying some strategy (eg. by surface capping), we could protect such aggregation at least up to some extent which enables the NPs to remain dispersed as stable fluids. Solubility/dispersability of NPs can be fabricate by surface modification of NPs. Even, it is possible to synthesize hybrid NPs by organic-inorganic combination in supercritical water. Also, doping is possible to increase the catalytic activity of NPs. Another lucrative application of NPs is the nanofluids (dispersion of NPs in base fluids). NFs are good for handling of NPs, and are prepared for heat transfer, mass transfer etc. Rheological properties of NFs such as viscosity are studied as it is related with thermal conductivity. Finally, NPs and NFs is considered as the new materials for next generation technology which can play excellent role in transportation, electronics, and catalytic, biomedical, metallurgy and many other industrial applications.

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**Technical Session-5D: Sustainable Green Technologies for Environmental Management**

Session Chair: Dr. Sirajul Hoque, DU  
Session Co-Chair: Abu Anis Jahangir, BCSIR  
Venue: ITTI-411/Dhaka Labs.

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## Natural waste products for removal of heavy metals from aqueous solutions and industrial effluents

M. E. Hossain, H. T. Moutushi, A. S. Razzaque, S. A. Hossain and S. Hoque

*Department of Soil, Water and Environment, University of Dhaka, Dhaka-1000, Bangladesh*

### Abstract

Some natural waste products were screened out to see their efficacy for removal of lead (Pb), cadmium (Cd), and chromium (Cr) from aqueous solutions and industrial effluents. Natural waste products selected for the screening include sawdust and banana peel. Sawdust materials tested were Kerosene (*Cordia subcordata*), Eucalyptus (*Eucalyptus globulus*), Shimul (*Bombax cieba*), Chambol (*Artocarpus chama*), Segun (*Tectona grandis*) and Koroi (*Albizia lebbeck*). Among the six tested tree species, Kerosene sawdust was found to be more suitable for adsorption of Pb(II) and Cd(II) ions from the synthetic solutions. The removal of Pb(II) and Cd(II) ions at equilibrium time of 60 min was found to be ~72% and ~29%, respectively. The maximum metal retention capacities were 12.195 and 4.505 mg/g for Pb(II) and Cd(II) ions, respectively. Dried banana (*Musa sapientum*) peel was tested for the removal of Pb(II) and Cr(VI) from aqueous solutions. Batch studies were conducted with dried banana peel (0.2 g for Pb and 1.0 g for Cr) using a 50 mg/L of aqueous solution and the equilibrium was obtained at 120 min with a 90% Pb(II) and 75% Cr(VI) removal. From the Langmuir isotherm, the maximum adsorption capacity was found to be 67.11 mg and 26.10 mg/g of the dried peel for Pb(II) and Cr(VI) ion, respectively. Adsorption of all the metals followed the pseudo-second-order kinetic model indicating chemisorption as the rate-limiting step in the adsorption process. To determine the feasibility of using the tested biosorbents in the real-life world, industrial effluents from lead-acid battery, automobile battery, zinc sulfate manufacturing, and textile dyeing industries were treated with Kerosene wood sawdust and effluents from lead-acid battery, textile dyeing and agro-machineries industries were tested with banana peel biosorbent for heavy metal removal. The efficacy of kerosene wood sawdust was the highest with the effluent of the textile industry and the banana peel biosorbent was found to remove the highest Pb and Cr from the effluents of agro-machineries manufacturing and textile dyeing industries, respectively. The present work has enormous implications considering the magnitude of industrial pollution in the country.

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## Promoting sustainable technology to reduce emission load from brick kilns in Bangladesh

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### Abstract

Bangladesh is the 4<sup>th</sup> largest producer of clay fired bricks in the world. According to a survey in July, 2018, there are about 7400 brick fields in Bangladesh. The brick sector contributes ~1% of country's GDP. The growth rate of this sector is about



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5.3%. The total annual brick production is estimated at 23 billion pieces. Total coal consumption is 5.68 million tons. The total emissions from the brick manufacturing in the Greater Dhaka region has been estimated at 23,300 ton of PM<sub>2.5</sub>, 15,500 ton of sulfur dioxide (SO<sub>2</sub>), 302,000 ton of carbon monoxide (CO), 6,000 ton of black carbon and 1.8 million tons of CO<sub>2</sub> emissions from the clusters of brick kilns, to produce 3.5 billion bricks per year. The releases of toxic substances from these brick kilns are adversely affecting soil, plants, animals and people in their surroundings being the most severe for brick workers, children and women.

Recognizing the importance of abating air pollution, the DoE issued an order that requires converting the existing brick kilns with 120 foot chimneys (i.e. FCK) to Zigzag and other low emission improved technologies by June 30, 2016. An interest created among the brick field owners to adopt and shift to newer technologies have resulted. About 70 percent of the FCKs have been converted to Zigzag Kilns using local artisans. Some FCK were accurately converted, but rests of them were not converted accordingly. The environment performances of these kilns are not well known. There is no specific data of emission load of these converted kilns. These kilns are required to be categories according to their energy and environment performances.

There are four different technologies being used in brick kilns in Bangladesh such as Fixed Chimney Kiln (FCK), Zigzag, Hybrid Hoffman (HHK), and Tunnel Kiln. These four different technologies of brick making were selected for this study. Two categories of environment monitoring were performed: a) stack emission and b) ambient air quality monitoring. Stack emission calculation is a very useful format to measure the overall pollution load that a specific technology may release into the environment. Real-time data of flue gases (SO<sub>x</sub>, NO<sub>x</sub>, O<sub>2</sub>, CO<sub>2</sub> and CO) was recorded at different day times (which include both coal feeding and non-feeding stages). The temperature, flow velocity and flow rate of stack gases were also monitored.

It was observed that the highest emission of flue gases and PM was found in traditional FCK, whereas the lowest was obtained in improved HHK and tunnel kilns. The average emission load of HHK and TK were 5 to 9 times lower than that of FCK. Emission of gases and PM were reduced by using gravitational settling chamber and water based scrubber for pollution control in brick kilns. Among these kiln technologies, the FCK is the least efficient and most polluting and the Tunnel, the most efficient and less polluting. Other technologies such as Zigzag and HHK are substantially cleaner, consuming less energy and emitting much lower amounts of pollutants, but are still being piloted in Bangladesh and are, therefore, at an early adoption stage.

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## **Current scenario of arsenic in ground water of Bangladesh**

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<sup>2</sup>*Commonwealth Scientific and Industrial Research Organization (CSIRO), Melbourne, Australia*

### **Abstract**

We Bangladesh committed to ensure the clean water and sanitation for all by 2030 which is one of the important sustainable development goals (SDG 6). Arsenic in ground water is one of the major problem of the 61 out of 64 district in Bangladesh. From 1993 to 2018 government has taken several initiative to ensure arsenic free drinking water for affected areas. As a result arsenic affected people decrease from 30 million to 10 million. But still these numbers are quite high and most alarming situation importantly every day hundreds of people are affected various arsenicosis diseases. Besides last 10 years there is no field survey i.e. no quantitative or qualitative statistical evidence that how many area are newly affected and what's present scenario of existing identifying tub wells and even no field test kit available to identify the arsenic in drinking water. What is



the source of arsenic in ground water of Bangladesh, what are the possible mechanism and why species variation in different parts of West Bengal? This is the million dollar question. Based on this above background in mind we summarized the background history as well as literature review, try to understand the possible mechanism. Based on this critical review we collect some samples in different parts of Bangladesh and try to understand the possible mechanism. Based on our case study and laboratory analysis we development the arsenic detection kit for in-situ analysis which is very cheap, indigenous source and easy to handle. We strongly believe that our arsenic development kit helps to design the arsenic mitigation technology that will ensure the filament of sustainable development goal 6.

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## **Arsenic and selenium content in some arsenic affected areas of Bangladesh and its possible relevance to arsenicosis disease**

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### **Abstract**

Contamination of groundwater as well as food chain by arsenic (As) is a serious public health problem in Bangladesh as high level of arsenic has been detected in 61 out of 64 administrative districts. More than 38,000 people were diagnosed with arsenicosis in different arsenic hotspot areas of Bangladesh. However, in some arsenic affected areas, no arsenicosis patients have been identified yet. The present work was conducted to find out any relevance of selenium (Se) content in soil, water and in edible plants grown on some hotspots of arsenic affected areas of the country where arsenicosis patient are prevalent and where no arsenicosis patient have been identified yet. Soil, plant and water (both drinking and irrigation) samples were collected from some arsenic hot spots areas of five localities *viz.* Chapainawabganj, Sonargaon, Manikgonj, Munshigonj and Ishwardi. The collected plant was Arum (*Colocasia esculenta*) - a hyper accumulator of As and a very common edible vegetable all over the country. Soil, plant and water samples were analyzed by atomic absorption spectrophotometer with hydride vapor generator (Shimadzu, AA-7000) to determine the arsenic and selenium content in them. Results obtained from the analyses reveal that the average concentrations of As in the three types of samples at the locations where arsenicosis patients are prevalent at higher than where arsenicosis patient has not been reported. On the other hand, the Se contents showed a reverse phenomena; lower in the locations where patients are prevalent than where no patients have been reported. The findings are suggestive of the implication of selenium in alleviating arsenic toxicity in human beings.

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## **Efficacy of Humic Substances of Indigenous Sources for Heavy Metal Removal from Aqueous Solution**

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### **Abstract**

Water pollution by heavy metals has become a public concern due to the development of high-technology industries around the world. The present work was conducted to remove Pb, Cd, Cr and Ni from spiked aqueous solutions using humic substances of Khulna peat in Bangladesh. Humic and fulvic acid, two major component of humic substances, make up an important part of soil organic matter and play an important role in metal complexation. Coagulation ability was performed in batch experiment. Optical property of humic acid was investigated. Carbon content of humic substances was measured and it was adjusted to  $1 \times 10^{-4}$  gm per litre at pH 7.00 for treatment. The ability of humic substances for removal of heavy metals was studied from individual and mixed solution. No sign of coagulation was observed within one week in case of the standard solution of Cd and Ni with the humic substances. Fulvic acid extracted from peat did not remove any heavy metals from the standard solution. Atomic absorption spectrophotometer was used to quantify heavy metals content in the aqueous solution before and after treatment. It was observed that humic substance was considerably effective in removing Pb and Cr from aqueous solution. Of the two metal ions examined, Pb appeared to have the strongest affinity towards humic acid and Cr was found to form the most stable complexes with the humic substances (combination of humic and fulvic acid). Metal removal process made the method useful for wastewater treatment.

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## **Chemical technology approaches to remediate metal contaminated soil in Bangladesh using humic substances in combination with synthetic extractant**

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### **Abstract**

To remediate metal contaminated soils by chemical technologies soil samples were collected from six metal contaminated industrial areas. The Pb concentrations were high (245 and 164 mg kg<sup>-1</sup>) in soils of battery industries of Madhupur tract (acidic soil) and Ishwardi (calcareous soil), respectively. Soil of tannery industrial area contained high amount of chromium (256 mg kg<sup>-1</sup>). The saline soil of ship breaking yard, Shitakunda had high amounts of Pb, Cr, Ni, Cu and Zn of 93, 71, 69, 192, 845 mg kg<sup>-1</sup>, respectively. Other two soil samples were collected from cable industry of Kushtia (calcareous soil) and Chittagong (slightly saline), which contained 196 and 151 mg kg<sup>-1</sup> of Cu, respectively. The mobility indexes of metals were found high (above 40%) in calcareous soils.



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Different synthetic extractants ( $\text{NH}_4\text{OAc}$ ,  $\text{CaCl}_2$ ,  $\text{HCl}$ ,  $\text{EDTA}$ ,  $\text{DTPA}$  and distilled water) were applied to spiked soils for removal of metal. Among the metals the highest amount of Cd and lowest amount of Cr were removed from soils by these extractants. The metal removal efficiencies of extractants were found higher in light textured soils than that of heavy textured soils. Among the extractants distilled water removed the lowest amount of metals from all soils. Between the salt solutions, buffered  $\text{NH}_4\text{OAc}$  extracted comparatively higher amounts of metals than that of  $\text{CaCl}_2$ . The extractants 0.1 M  $\text{HCl}$  extracted significantly high amount of metals, but the extraction markedly reduced soil pH and also leached a high amount of plant essential elements like Ca, Mg, Fe and Mn. Moreover  $\text{HCl}$  could not extract much metal from calcareous soils. The chelating agents  $\text{EDTA}$  and  $\text{DTPA}$  extracted considerable amounts of metals from all types of soils. These extractants effectively lowered the mobility indexes of metals below 10% in acidic and saline soils and 8 to 29% in calcareous soil. Among the chelating agents,  $\text{EDTA}$  removed the highest amount of metals from soils, but its use is also problematic one if persists in the environment.

Soluble humic substances (HS) might be used instead of synthetic chemicals. Humic substances act as chelating agents for metal ion extraction which are also less expensive, environment friendly, less destructive to soil structure and improve soil properties. Different concentrations of humic and fulvic acids (0.1 to 0.5%) were used for removal of metal from soils. Fulvic acid extracted comparatively higher amount of metals from heavy textured soils of Madhupur, Ishwardi and Kushtia due to its lower molecular structure than that of humic acid. In contrast humic acid leached somewhat higher amount of metals from light textured soil of Hazaribagh and Shitakunda due to having more contact time with soil particles.

Humic substances (HS) reduced metal mobility in soils but the values were comparatively higher than that of  $\text{EDTA}$ , because HS extracted comparatively lower amounts of metals from soils (especially from calcareous soil) compared to  $\text{EDTA}$ . The extraction capacities of humic substances were significantly increased when combined with small amount of  $\text{EDTA}$ . Combined HS +  $\text{EDTA}$  extractants reduced the mobility indexes which were also lower than that of individual HS and  $\text{EDTA}$  treatments. In heavy textured soils of Madhupur tract and in calcareous soils 0.4 % fulvic acid in combination with 0.04 M  $\text{EDTA}$  extracted similar amounts of metals as was done by only 0.1 M  $\text{EDTA}$  solution, whereas humic acid required 0.06 M  $\text{EDTA}$ . Both humic and fulvic acids required lower amounts of  $\text{EDTA}$  (0.04 M) to remove metals from light textured soils of Hazaribagh and Shitakunda as was done by  $\text{EDTA}$  alone.

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## **Transformation of Lead and Cadmium in contaminated surface soil as affected by applied organic matter**

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<sup>2</sup>*Department of Soil, Water and Environment, University of Dhaka, Dhaka-1000, Bangladesh*

### **Abstract**

To study the transformation behavior of lead and cadmium in soils with time upon addition of organic matter, laboratory experiment was conducted. Contaminated surface soils near Dhaleshwari river of Bangladesh were selected for this study. The selected soils were silt loam, silty clay loam and silty clay in texture. For conducting this experiment, all the determination was performed triplicate. In this experiment, organic matter was applied at a rate of 5 ton/ ha in a moist condition in both un-spiked and spiked (with lead nitrate and cadmium nitrate solution) soils. All soils were incubated for 30 days at 30 % moist condition. Metal in the incubated soils was fractionated at three different time intervals (24 h, 3 days and 30 days) by the sequential



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extraction procedure of Salbu et al. (1998), as modified from that of Tessier et al. (1979). Although redistribution of metals among different fractions was observed in both treated (with organic matter) and not treated soils, variations were observed in each case. In general, transformation of metal occurred from mobile to immobile fractions both in un-spiked and spiked soils. But organic matter increased the mobile fractions of Pb and Cd in un-spiked soils while it decreased the mobile fractions of metals in spiked soils. The mobile fraction (as percentage of total) of Cd was higher than the mobile fraction of Pb which indicated the greater mobility of Cd compared to Pb.

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## Monitoring the metal contamination in the sediment and Bivalves from part of the Bay of Bengal and its environmental impacts

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<sup>4</sup>Senior Scientific Officer, freshwater Station, Bangladesh Fisheries Research Institute, Mymensingh

### Abstract

Bivalves, particularly mussels and oysters, have been extensively studied and used to monitor metal contamination in coastal systems and to reveal the bioavailability of contaminants. Thus, it can be regarded as bio-indicators of the ambient contamination status of water rather than sediments. There, the bivalve tissues have nutritional and economic values, eating bivalves with high concentrations of heavy metals is dangerous and threats to human health. So, to assess the heavy metal contamination of sediment and bivalves are crucial. For this study, sediment samples were collected from Chittagong sea beach, Parki sea beach, Cox's bazar, Maheshkhali and Saintmartin island and bivalves samples were collected from Maheshkhali and Saintmartin island because bivalves are not available in all areas of Bangladesh. Four metals (Zn, Cr, Pb, and Cd) were approximate analyzed with Atomic Absorption Spectrophotometry (AAS) to assess the level of metals in the sediment and bivalves viz. *Crassostrea madrasensis*, *Anadara granosa* and *Meretrix meretrix*. Result of this study reveals that the metals content (mg/kg) showed the following order in sediment; Zn (10.51-48.58) > Cr (1.4-52.37) > Pb (1.69-13.28) > Cd (0.02-3.41) and in bivalves, Zn (56.35-808.22) > Cd (1.097-86.91) > Pb (0.1-1.69) > Cr (0.07-0.46). In sediments and bivalves the content of metals are below the limit recommended by the World Health Organization except for Zn and Cd in the bivalves. Zn were found higher in Clam (*Meretrix meretrix*) and Cd were found higher in Oyster (*Crassostrea madrasensis*). These elements exceed the limits set by WHO and might have the chance to increase day by day due to the various natural and anthropogenic activities. Therefore, the study suggests that the level of different metals in sediment and Bivalves should continuously be monitored to assess the effect of these metals on the fragile ecosystem.

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**Technical Session-6A: Pulp & Cellulosic Products**

**Session Chair: Prof. Mohammed Kamal Hossain, CU**  
**Venue: ITTI, Room no. 611**

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## **Bioinspired Functional Nanocomposites from Paper and Edible Additives**

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### **Abstract**

Nature has limitless reserves of ideas for materials design and innovation. Wasps and bees build paper nests by combined processes of “biofiber separation from lignocellulosic resources” and “biofiber reassembly”, where they add their own saliva (“a functional additive”) to harden the delicately designed assemblies. Rice leaves’ epidermises containing biowax and silica are the foundation of natural features such as those related to directional self-cleaning and defensive barriers. With these fascinating phenomena in mind, we herein present a bioinspired concept of forming functional bionanocomposites from biowax-silica hybrids, gelatin, and mass-producible biofiber assemblies. Biowax, silica, and gelatin used in the current study were all edible materials. Biowax-silica hybrids were formulated to mimic the rice leaf epidermal structures, and gelatin was used as a bidirectional binder to facilitate strong anchorage of such structures to biofiber assemblies. Thermal annealing under mild conditions (at temperatures above the melting point of biowax) was adopted to “harden” (consolidate/refine) as-formed bionanocomposites and induce the construction of transparent coatings, essentially built upon interactions involving molecular redistribution and structural reorganization. As expected, the consolidated bionanocomposites with cuticle-like surface features show pronounced feature of self-cleaning superhydrophobicity. Our findings suggest that the strategy of spraying biowax-silica hybrid dispersion to gelatin-deposited substrate followed by thermal annealing is easily scalable, and it would be facilely integrable into mass-production processes of biofiber assemblies as surface sizing/coating. In light of intrinsic characteristics of self-cleaning superhydrophobic structures and biowax, other expectable features of the strategy would involve antibacterial properties and fruits/vegetables preservation. This strategy would direct regular biofiber assemblies toward diversified applications. Examples of applications are: (1) food-related containers or packaging materials that can reduce or eliminate aqueous liquid residues; (2) preservation of historic/artistic works; (3) scientific demonstrations pertaining to surface engineering and bionics; and (4) children-related safe products.

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## **Environmentally friendly approach to produce bleached pulp from rice straw**

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### **Abstract**

Pulp and paper industry are indispensable for any civilized country. The demand and consumption of paper is increasing day by day due to the fast growth of population, urbanization and industrialization. Traditional chlorine-based bleaching agent release huge chlorinated compounds that are highly toxic and carcinogenic in nature. So, it is immediately needed to find out alternative and renewable source of raw materials as well as eco-friendly pulping and bleaching sequences for pulp and paper industry. Rice straw is a renewable lignocellulosic material abundantly grown in wood short countries like Bangladesh, India, China etc. and can be used as a raw material for this industry. Open burning of rice straw produces huge greenhouse gases that have the serious threats to global warming and human health. So, it is a dual benefit option to use rice straw as a raw material



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in pulp and paper industry. Rice straw contains less lignin (cellulose 35.5%, hemicellulose 30.3%, lignin 14.9% and silica 8%) as compared to wood-based raw materials. Therefore, it needs less drastic cooking conditions during processing period. Most of the hemicellulose and silica are removed when apply alkaline treatment with 4% sodium hydroxide (NaOH) solution at 65°C for 1 hr. A mild bleaching with peracetic acid solution at 65°C for 45 min. is enough to remove rest of the lignin and hemicellulose which is an eco-friendly and cost-effective way to minimize the problems of chlorinated compounds in waste water of paper mills. Such approach of using rice straw as a raw material with its environmentally safe processing for making paper can prove to be valuable towards sustainable growth.

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## **Application of pulp and paper industry wastes in environmental pollutants removal**

**M. A. Islam<sup>1,2\*</sup>, D. W. Morton<sup>2</sup>, B. B. Johnson<sup>2</sup> and M. J. Angove<sup>2</sup>**

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### **Abstract**

The use of pulp and paper is increasing World-wide, and wastes are therefore being produced in appreciable amounts. These wastes often pose serious disposal problems and degrade the nearby environment. They are commonly disposed of through combustion and landfill. Thus, their use as adsorbents is promising and high priority because it could lead to a reduction in cost for waste disposal. Moreover, wastes from paper and pulp manufacture include a number of cellulosic materials and have potential as adsorbents due to their high carbon content, the presence of oxygenated functional groups and cellulose fiber. Recently, rapid industrialization and development has released large volumes of pollutants including metal ions, dyes, phenol, pesticides and pharmaceuticals into the environment. Due to their toxicity, several procedures have been developed for their safe removal using paper wastes. Several studies have shown the potential of paper waste in wastewater treatment, but an overview of related aspects has been missing. Therefore, this study summarizes the recent development and applicability of various paper wastes for the efficient removal of pollutants from wastewater and the results reported in terms of maximum removal capacity. The paper also highlights the possibilities, limitations and future innovations in this area. Results indicate that paper wastes can be utilized instead of more conventional, but expensive, adsorbents, particularly in developing countries where many industries lack waste management systems. Adsorption efficiencies are affected by the characteristics of the waste, the activation method and experimental conditions. Adsorbents from paper industry wastes can remove metal ions by both precipitate formation and chemi-sorption onto available functional groups. It is anticipated that modification of paper industry wastes by means of thermal or chemical processes or by the impregnation of functional groups may improve the pollutant adsorption capacity of these waste. Paper waste is a promising future generation adsorbent for the removal of pollutants on a large scale.

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## **Starch-based biocompatible composite hydrogels and its applications**

**H. J. Kadri, Md. I. H. Mondal\* and Mst. S. Yeasmin**

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

At present researchers are interested to create biodegradable and biocompatible products to minimize the environmental pollution caused by petroleum-based synthetic polymers. In this investigation the starch-based hydrogel was synthesized by direct grafting of acrylamide (AM) onto potato starch in the presence of potassium persulphate as free radical initiator and citric acid (CA) as a crosslinker. Then, PLA was dissolved in 1% THF or 1,4-dioxane and then added to the prepared copolymer at 50°C. The developed PLA starch-g-PAM hydrogels was characterized by ATR-FTIR, SEM, XRD and TGA. The thermal behavior of the hydrogels showed improved thermal stability. FTIR identified the reaction product and porosity was observed with scanning electron microscope. The hydrogel is transparent and showed better moisture absorption capacity and high swelling properties in aqueous solution. The structure, formation mechanism, water absorbency, pH sensitivity, reversibility, biodegradability biocompatibility of the hydrogels were also investigated. The results showed that the prepared starch-based composite hydrogel is biodegradable as well as biocompatible which will be suitable for food packaging and biomedical applications.

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## **Synthesis and characterization of carboxymethyl chitosan and its polylactic acid copolymer as ecofriendly modifier for cotton fabric**

**T. Akter, Md. I. H. Mondal\* and F. Ahmed**

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

This paper reports the synthesis and characterization of carboxymethyl chitosan and its polylactic acid copolymer as eco-friendly modifiers for cotton fabric to enhance the effectiveness for intensified textile use through graft copolymerization techniques to substitute toxic textile chemicals and investigated dyeability of unmodified and modified cotton fabrics. Chitosan, carboxymethyl chitosan (CMCh) and carboxymethyl chitosan-g-polylactic acid (PLA) were successfully synthesized by deacetylation of chitin, carboxymethylation of chitosan and graft copolymerization of CMCh respectively. The molecular weight, moisture content and ash content of prepared CMCh were 2,06,179 Dalton, 19.5% and 14.95% respectively. The optimized conditions of graft copolymerization of polylactic acid onto CMCh were 10 g/L potassium persulfate, 2 g/L polylactic acid, 2 g/L methylene-bis-acrylamide at 70°C for 3 h. Both CMCh and CMCh-g-PLA copolymers were identified by Fourier Transform Infrared Spectroscopy (FTIR). Cotton fabric was modified with prepared CMCh and CMCh-g-PLA and the selected conditions for the fabric modification were 50% modifier (on the weight of fabric) at 60°C for 60 min. The CMCh and CMCh-g-PLA modified fabrics were characterized by FTIR and SEM, TGA and DTA. The thermal behavior of modified fabrics showed comparatively higher thermal stability than that of unmodified fabrics. It was observed that modification improved chemical resistance, moisture resistance, swelling resistance in different solvent and tensile strength of cotton fabric. The modified fabrics were dyed with Reactive Orange 14 and Direct Orange 31. The modified fabrics showed better dyeability and colour fastness properties. The results suggested that CMCh and CMCh-g-PLA are expected to be promising modifiers for cotton fabric.

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## **Fabrication and characterization of quaternary chitosan based ZnO based nanocomposit film for biomedical applications**

**Md. N. Huda, Md. I. H. Mondal\* and F. Ahmed**

*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

N,N,N-trimethyl chitosan chloride (TMC) was synthesized by reductive methylation of chitosan (DD, 90% and mesh size, 100) between chitosan and iodomethane in presence of sodium hydroxide. Zinc oxide (ZnO) nanoparticles were synthesized by wet chemical method. TMC particle and zinc oxide (ZnO) nanoparticle were characterized by FTIR spectroscopy and scanning electron microscopy (SEM). TMC and ZnO-nanoparticle in powder form were suspended in water at room temperature and sonicated for 10 min, then characterized by UV-Vis spectroscopy. The prepared quaternary chitosan-based ZnO nanocomposite has antimicrobial activities against *Staphylococcus aureus* and *Escherichia coli*. Bacteriological tests such as minimum inhibitory concentration (MIC) and disk diffusion method were performed in nutrient agar media. TMC exhibited improved water solubility and stronger antibacterial activity relative to chitosan (CS) over an entire range of pH values; thus, this quaternary modification increases the potential biomedical applications of chitosan in the field of anti-infection. Both TMC and ZnO nanoparticles increase the antibacterial activity of the prepared composite and it has enhanced wound healing properties. Again, as the composite is biobased, it is biodegradable, biocompatible and nontoxic.

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**Technical Session-6B: Pulp & Bleaching-5**

**Session Chair: Prof. Yonghao Ni, UNB, Canada**  
**Venue: ITTI, Room no. 612**

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## New process for production of functional textile from cellulose fibers

M. N. Alam<sup>1\*</sup> and T. V. D. Ven<sup>2</sup>

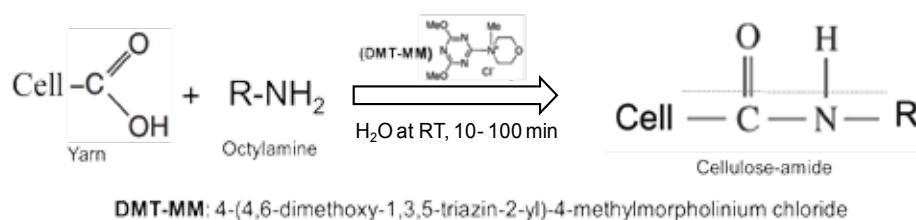
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<sup>2</sup>*Department of Chemistry, McGill University, Montreal, QC, Canada*

### Abstract

Recently, fibres from regenerated cellulose, such as rayon and Lyocell, have been increasingly used to enhance the comfort and softness of nonwoven products. Viscose rayon is a wet-spun fibre from regenerated cellulose produced by xanthation of dissolving pulp or cotton linter using a toxic carbon disulphide (CS<sub>2</sub>). During the spinning process of rayon manufacturing, this toxic compound is released and has to be captured and recovered to minimize impact on human health. To alleviate the environmental problems with conventional textile production, we have developed an aqueous-based, non-toxic process to produce textile yarns from cellulosic material by chemical modification (carboxymethylation reaction) of pulp fibres using a wet-spinning process. The resulting textile yarns have a degree of substitution (DS) of carboxyl groups (COOH-) ranging from 0.1 to 0.4 which greatly improves the hydrophilic behavior of the produced textile. As a result, the water absorbency of the textile product increases to 150 g H<sub>2</sub>O/g textile (in water) and 20 g H<sub>2</sub>O/g textile (in 0.9 % NaCl solution). The carboxymethylated textile fibres as such are well suited for use in nonwoven products that require high liquid absorption capacity, including infant diaper, feminine hygiene, incontinence pads, medical/surgical applications, etc.

However, due to the high value of water absorbency, the hydrophilic textile yarn is not suitable for textile applications such as apparel. To minimize water absorbency and make it more compatible with that of cotton fabrics (water uptake of 1.5 g H<sub>2</sub>O/g yarn), hydrophobization of the functional yarns is performed via an amidation reaction using different activator. This way the functional groups of yarn and its hydrophobicity can be controlled by a targeted substitution of hydrophilic carboxyl (COOH-) groups with hydrophobic/less hydrophilic secondary amine groups:



Scheme 1: Surface hydrophobization of functional textile yarn using an amidation reaction

Although cotton and rayon fibers are both made from cellulose, their properties are very different. Properties and potential applications of the surface-hydrophobized textile yarn as a substitute for cotton linters will be discussed.

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## Mussel-inspired cellulose-based adhesive

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### Abstract

In nature, marine mussels are able to adhere tightly to a variety of surfaces like rocks, woods, metals, organisms, and even low-surface-energy polytetrafluoroethylene (PTFE), in wet and turbulent environment by strong byssal threads. Inspired by marine mussel, catechol-containing materials, including adhesives, self-healing hydrogels, and antifouling coatings have been developed with wide applications in chemical, biomedical, and electronics industries. Conventionally, petrochemicals or organic solvents are widely used for the preparation and dissolving of the adhesives, generally making the adhesives not eco-friendly and biocompatible. Cellulose is the most abundant biomacromolecule in nature with good biodegradability and biocompatibility, which can be physically or chemically modified to produce functional materials. Here we report catechol-containing cellulose-based tissue adhesives, synthesized using 2,2,6,6-tetramethylpiperidine-1-oxyl (TEMPO)-oxidized cellulose and dopamine hydrochloride. The TEMPO-oxidized cellulose with carboxyl contents of 2.02 mmol/g was obtained by oxidizing cellulose using TEMPO, NaBr, and NaClO solution. The structures of the adhesives with different catechol contents were analyzed by UV-vis spectroscopy, Fourier transform infrared spectroscopy (FTIR) and nuclear magnetic resonance (<sup>1</sup>H NMR) spectroscopy. The adhesion strengths were examined using porcine skin by lap shear tensile tests. The adhesion strength of the as-prepared adhesive was 20.0 kPa. Fe<sup>3+</sup> was used as crosslinker to enhance the adhesion strength and accelerate the solidification of adhesives. Through the Fe<sup>3+</sup>-catechol coordination, the adhesion strength of cellulose-based adhesive with catechol content of 16.5 mol% was increased to 88.0 kPa, showing strong mechanical strength compared to the fibrin adhesive. The cellulose-based adhesives show good biocompatibility to living organisms and the NIH 3T3 cells on the adhesives exhibit a flourishing living state. Our investigation offers a bio-inspired strategy to fabricate biocompatible adhesive for the application in wound suture and tissue engineering.

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## Dissolving pulp from crops residues by prehydrolysis-potassium hydroxide process

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### Abstract

The main driving force of Bangladesh economy is garments sector, which requires a substantial amount of imported rayon fiber. Rayon is produced from dissolving pulp. Bangladesh is a forest scarce, populated agrarian country, generated a large amount of crops residues, those can be exploited into dissolving pulp. Environmentally, crops residue pulping is not feasible. To overcome the environmental problem, potassium hydroxide (KOH) has been proposed. In this paper, dissolving pulp was produced from five crops residues, namely rice straw, wheat straw, jute stick, corn stalks and dhaincha by prehydrolysis -KOH process with varying KOH charge. Prehydrolysis of crops residues facilitates delignification, therefore, the kappa number of these pulps were reached to below 10. Pulp yield in prehydrolysis-KOH process was better than conventional prehydrolysis-kraft process. Dhaincha had the highest pulp yield among these five raw materials followed by wheat straw. All pulps showed good bleachability in D<sub>0</sub>E<sub>p</sub>D<sub>1</sub> bleaching sequences. The purity of these pulps was 85-91%  $\alpha$ -cellulose with





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41-66% fock reactivity. The residual pentosan content of the produced dissolved was below 5%. Cold KOH extraction of these pulps increased  $\alpha$ -cellulose content to 90%. Finally it can be said that prehydrolysis-KOH process can be used for producing rayon grade dissolving pulp from crops residues.

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## **Formation of methylcellulose and zinc oxide nano composite hydrogel and evaluation of antimicrobial activity**

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*Polymer and Textile Research Lab, Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Rajshahi-6205, Bangladesh*

### **Abstract**

Methyl cellulose is a chemical compound produced from cellulose, extracted from wheat straw, treated with methyl iodide for under heterogeneous conditions. Solubility of methyl cellulose (MC) depends on the degree of substitution (DS), the average degree of polymerization (DP), and the distribution of methoxyl groups. However, DS lower than 2.5 the polymer shows solubility in water, and the product has many applications in pharmaceutical and biomedical fields. Again, ZnO nanoparticle were synthesized by green synthesis method using the leaves of *Ocimum Tenuiflorum* and *Azadirachta Indica*. Both plant act as reducing and stabilizing agent in the synthesis of ZnO nanoparticle. The prepared ZnO nanoparticles were characterised by TEM, FTIR, AFM etc. ZnO nanoparticle exhibited antimicrobial activity against both gram positive and gram negative bacteria. Hydrogel was synthesized by simply free radical graft copolymerization between acrylamide and 2-hydroxyethyl methacrylate with methyl cellulose, in presence of methylene-bis-acrylamide as crosslinker and potassium persulphate as initiator. For the synthesis of antimicrobial hydrogel, ZnO nanoparticle was added to the prepared hydrogel. The products were characterized by physical methods as well as instrumental techniques. It was found that water holding capacity and crosslinking capacity decrease with the increase in antimicrobial agent. Thus the synthesized hydrogel could be used as an ecofriendly hydrogel in personal health care products as well as in biomedical field.

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**Technical Session-6C: Materials and Metallurgy-Bio-malarials**

**Session Chair: Prof. Farid Ahamed, JU**  
**Venue: IFRD Auditorium**

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## Preparation and analysis of poly (*L*-lactic acid) based composites with oligo(lactic acid) grafted cellulose and micro-crystalline cellulose

Md. H. Rahaman<sup>1\*</sup>, M. A. Gafur<sup>2</sup>, Md. A. Haque<sup>1</sup>, Md. M. Rana<sup>1</sup> and Md. A. Islam<sup>1</sup>

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### Abstract

$\alpha$ -cellulose and micro-crystalline cellulose (MCC) extracted from jute fiber are grafted with Oligo (lactic acid) (OLA) via graft poly-condensation reaction in presence of para-toluene sulphonic acid and potassium persulphate in toluene at 130°C for 3, 6, 9, 12, 15 and 18 h under 380 mmHg. Here OLA is synthesized by ring opening polymerization of lactides in the presence of stannous octoate (0.03 wt% of lactide) and lactic acids at 140°C for 10 h. Composites of poly (*L*-lactic acid) (PLLA) with OLA grafted  $\alpha$ -cellulose and micro-cellulose are prepared by solution mixing and film casting method. Grafting of OLA onto  $\alpha$ -cellulose and micro-cellulose are confirmed by FTIR and SEM. Grafting efficiency increase with increasing grafting time and better for MCC as compared to  $\alpha$ -cellulose which is observed from SEM analysis. Composites characterizations are carried out by FTIR, SEM, WAXD and DSC. Distributions of grafted  $\alpha$ -cellulose in composites are uniform and have better compatibility with PLLA through intermolecular hydrogen bonding. Only homo-crystalline structures of PLLA present in the composites and the thermal stability is increasing with the increasing the percentage of grafted  $\alpha$ -cellulose.

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## The development of ZnO nanoparticle coated different fabrics for medical applications

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### Abstract

In textile industry, cotton is the most popular choice among all the natural fibers due to its unique properties such as softness, affinity to skin, biodegradability, absorbency and being comfortable to wear. Zinc oxide nanoparticles (ZnO NPs) were produced and coated on cotton fabrics. Concentration of Zinc acetate was varied. 2-methoxy-ethanol has been used as solvent. Using dip coating technique, ZnO NPs have been coated on the cotton fabric in different mole concentration. Scanning Electron Microscopy (SEM), Ultraviolet Visible (UV-Vis) spectroscopy, the antifungal and antibacterial activity of the ZnO NPs were performed on the coated fabrics. It was found that the UV absorbance rate increases with the increase of concentration upto 2.5M concentration, and after that it decreases. It was also found that maximum antibacterial and antifungal activity was shown for 2.5M concentration.

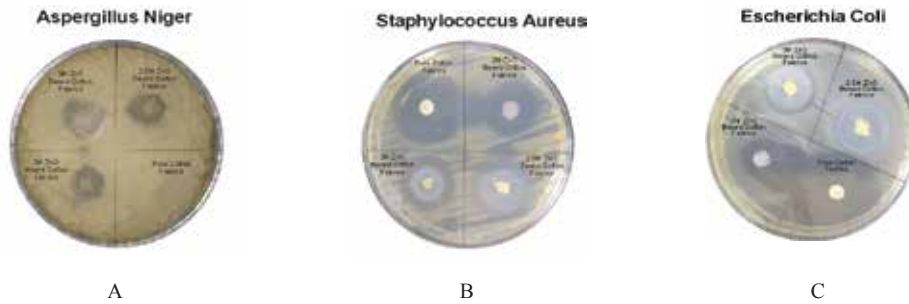


Fig. Antifungal and antibacterial activity of the pure and ZnO coated cotton fabrics against (a) *Aspergillus Niger* (b) *Staphylococcus Aureus* and (c) *Escherichia Coli* for different mole concentration of ZnO.

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## Fabrication and characterization of pure and zinc doped hydroxyapatite and comparing their mechanical properties under optimum sintering conditions

I. Khan\*, M. A. Gafur, S. A. Dhar, Md. R. Qadir, Md. A. R. Khan and A. N. Ahmed

*Pilot Plant and Process Development Centre, Bangladesh Council of Scientific Industrial Research, Dhaka, Bangladesh*

### Abstract

Hydroxyapatite (HAP) is a promising bioactive material which improves osteo-integration at the surface of the dental implants. Pure as well as Zinc (Zn) doped hydroxyapatite powders were synthesized using chemical method. The powders were characterized using X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and thermogravimetric analysis (TG). XRD results revealed the characteristic peaks of pure HAP and peaks shifted in case of Zn doped HAP. Vickers Micro hardness test revealed that the sintered tablets have hardness range of (100-250 MPa). The optimum sintering temperature was also attained for best compressive and flexural strength as well as for fracture toughness of the sintered tablets.

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## Effect of unstabilised Zirconia addition on structural and mechanical properties of Alumina-Zirconia composites

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<sup>2</sup>*PP & PDC, BCSIR, Dhaka, Bangladesh,* <sup>3</sup>*Department of Applied Chemistry and Chemical Engineering, Dhaka University, Bangladesh*

### Abstract

Alumina-Zirconia composites especially Zirconia Toughened Alumina (ZTA) shows better mechanical properties over alumina. Al<sub>2</sub>O<sub>3</sub>-ZrO<sub>2</sub> composites were prepared by powder compaction method varying ZrO<sub>2</sub> content from 0 to 20 vol% using



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small amount of MgO as sintering aid. The composites were sintered for two hours in air at 1580°C. At this temperature maximum density was achieved 99.2% of theoretical density for composite containing 20 vol% ZrO<sub>2</sub>. Density measurement of sintered composites was carried out using Archimedes's method. Hardness and fracture toughness measurement was carried out using Vickers indentation. Phase content was detected by means of X-ray diffraction (XRD). t-ZrO<sub>2</sub> retention was also determined by XRD analysis. Microstructure of the composites and grain size of alumina and zirconia was determined by Scanning Electron Microscopic (SEM) analysis. Maximum microhardness (17.35GPa) was achieved for composite containing 5 vol% ZrO<sub>2</sub> and maximum flexural strength (495.67 MPa) and fracture toughness (8.54 MPam<sup>0.5</sup>) was achieved for composite containing 10 vol% of ZrO<sub>2</sub>. The aim of the present work is to investigate the optimum zirconia content for obtaining maximum density, microhardness, flexural strength and fracture toughness of Al<sub>2</sub>O<sub>3</sub>-ZrO<sub>2</sub> composites.

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## **Fabrication of highly stretchable hydrogel using narrow dispersed modified nanosilica particles as cross-linker**

**Md. R. Karim<sup>1\*</sup>, A. B. Imran<sup>2</sup> and K. Nahar<sup>1</sup>**

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<sup>2</sup>*Department of Chemistry, Bangladesh University of Engineering and Technology (BUET)*

### **Abstract**

Hydrogels are widely used in diverse applications but the scope of their applications is often severely limited by their poor mechanical behaviors including low toughness and limited stretchability. Many attempts are carried out together to synthesize hydrogels with improved mechanical properties. However, yet to achieve the facile and universal approach to fabricate hydrogel with desired strength and biocompatibility. Nanocomposite hydrogelshave successfully fabricated with high tensile strength and toughness by reinforcing the network structure of acrylamide with grafted silica nanoparticles as cross-linker. Silica nanoparticles grafted with vinyl end groups using 3-(trimethoxysilyl) propyl methacrylate (MPTS) was used as macro-crosslinker during polymerization reaction of acrylamide in presence of modified silica (MSiO<sub>2</sub>) to form nanocomposite hydrogel. Here, 200nm silica was used to prepare MSiO<sub>2</sub>. The unique nature of synthesized nanocomposite hydrogel which contains both organic and inorganic substances led to their wide-spread applications as they have remarkable stretching, and toughness of ~ 59,400 Jm<sup>-2</sup> for the elongation. In addition,allthe synthesized hydrogels showed high transparency (above 75%) in the wavelengths of visible region light. The polymer chains inside the nanocomposite hydrogel can dissipate energy during applied stress while the chemical cross-links between MSiO<sub>2</sub> and polyacrylamide ensure the structural integrity, which could be responsible for the improved mechanical properties of fabricated nanocomposite hydrogel.

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**Technical Session-6D: Chemical Metrology**

**Session Chair: Md. Jaydul Islam, NML, BSTI, Bangladesh  
Venue: ITTI, Room no. 411**

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## Longevity of human being's life may be extended for food habits

S. M. M. Kabir

*Head of Quality Control, PRAN Group, Bangladesh*

### Abstract

From ancient period to till, food habits of human being are a natural and compulsory phenomenon. Food taking activity is also conducted from just born to before death. So obviously its category and characteristic donate a positive contribution of man's long life. Since the dawn of time human beings have been trying to improve the quality of the existence and extend their lifespan. Genetic, environmental, behavioral and dietary factors influence the pathways that regulate aging and life expectancy, thus rendering longevity a very complex phenomenon. Although a long-lived elixir has not yet been found, physicians and scientists agree that nutrition has a major impact on the overall mortality and morbidity, hence becoming the subject of a widespread scientific research. This review describes, analyzes and compares the effects of different types of diets in reducing the onset of typical Western countries non-communicable diseases (NCDs) (cardiovascular diseases, tumors, chronic respiratory diseases, diabetes, etc.), thus increasing the average lifespan. It will first depict the most relevant characteristics, nutraceutical properties and effects on the populations of the Mediterranean, Japanese, Vegetarian and New Nordic Diet. Finally, it will describe the impact of different dietary restrictions in modulating the genetic pathways that regulate metabolism and aging. These 10 foods or food stuff may also help to human good health as well as work on long life ; turmeric, goya (bitter melon), hechima (vegetable sponge), huchiba (mugwort), tofu, sweet potato, jasmine tea, arrowroot, konnyaku, seaweed. Overall, this work reinforces the evidence that specific eating habits, in addition to healthy and active lifestyles, are crucial to increase people's health span and to achieve an optimal longevity.

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## Fatty Acid Profiling of Human Coronary Atheroma in Perspective of Bangladesh

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<sup>2</sup>*Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka*

### Abstract

The incidence of Coronary Artery Diseases (CAD) is significantly higher in South Asian Region and is categorized into Type I, II & III forms. Depending upon the symptoms and risk, treatment are done by percutaneous coronary intervention or Coronary Artery Bypass Grafting (CABG) through which Atheromatous plaques, responsible for Myocardial Infarction (MI); are removed allowing sufficient blood flow to the cardiac muscle. No studies were carried out in Bangladesh to find out the fatty acid composition of human coronary atheroma. Plaques collected from 80 patients who underwent CABG without cardiopulmonary bypass were analyzed by GS- FID. The cholesterol and total fatty acids of coronary plaque were found to be in the range of 0.3- 9.8% with a mean of  $3.59 \pm 2.84\%$  and 0.5- 3.0% with a mean of  $1.47 \pm 0.76\%$  respectively. The most abundant fatty acid was palmitic acid (saturated)  $0.46 \pm 0.25\%$ ; followed by oleic acid (unsaturated)  $0.44 \pm 0.32\%$ . Since calcification is a common phenomenon in atherosclerotic arteries, calcium content of collected plaques were also analyzed by AAS and found to be in the range of 0.02- 14% with a mean of  $4.37 \pm 4.46\%$ . No statistically significant correlation was observed between plaque length, weight, calcium content and total fatty acids.

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## **Proficiency Testing (PT) Program on pH, Brix, Acidity and Benzoic Acid in Fruit Juice by Robust Statistics Techniques**

**Md. Moniruzzaman and M. Khan**

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### **Abstract**

A Proficiency Testing (PT) program on pH, Brix, Acidity and Benzoic Acid in Fruit Juice was conducted in eight (8) different testing laboratories of Bangladesh. The objectives of this program were to (i) assess the accuracy of measurement; (ii) evaluate the methods used by the laboratories for determination and (iii) develop the practical application of traceability and measurement uncertainty. The PT samples were prepared by spiking benzoic acid into locally available apple juice. The results returned by the participants were compared to the spiked concentration and no evidence of significant instability was observed (recovery 99%). The robust average and associated expanded uncertainty of participant's results, calculated by the procedure described in ISO 13528: 2005(E), was used as the assigned value for all the parameters in the sample. Of thirty (30) numerical results, twenty four (24) were reported with an expanded measurement uncertainty (80%), indicating that the four- fifth of participating laboratories have addressed the requirement of ISO 17025. Laboratory performance was assessed using both z-scores and En-scores. Twenty five (25) of Thirty (30) numeric results (83%) returned a satisfactory z-score with  $|z| \leq 2$ . Out of twenty four (24) numeric results twenty (20) returned a satisfactory (83%) En- score with  $|En| \leq 1$ . For the improvement of analysis, participants were recommended to calibrate their relevant equipment; pH Meter, Refractometer & HPLC for measurement of pH, Brix and Benzoic Acid respectively and standardize the base concentration for the measurement of Acidity.

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## **Development and Validation of Quantitative Method for Acrylamide in Food Matrix**

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### **Abstract**

A precise and accurate in house validate analytical method was developed for the quantification of acrylamide in fried food by Liquid Chromatography and Tandem mass spectrometric (LC-MS/MS), a probable carcinogenic compound in fried food items. The method was validated by assessment of linearity, specificity, precision, accuracy, selectivity and robustness with relative standard deviation of <4%. The calibration curves were found linear with correlation coefficient ( $r^2$ ) of 0.9997 over the concentration range 5 – 500 $\mu$ g/L. The recoveries were 97% to 104% by spiking of 250, 400 and 500 $\mu$ g/L of acrylamide. Based on the signal to noise ratio, the lower limit of detection (LOD) and lower limit of quantification (LOQ) were achieved 2.0 $\mu$ g/L and 4.0  $\mu$ g/L, respectively. The developed method was also applied to other available most popular 24 types of food (265 number of sample) for the first time in Bangladesh. The highest level of acrylamide has been found in potato chips (252.7  $\mu$ g/L), Chicken Grill, Sikh Kabab & Egg Fry lies between 104.32 to 187.22 $\mu$ g/L, whereas, baked food products exhibited less content in the range of 35.23 to 51.17  $\mu$ g/L.

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## Estimation of Uncertainty Components of Analytical Balance and Volumetric Glassware Calibration

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### Abstract

The present view concerning measurement, as expressed in the International Vocabulary of Metrology, is that without knowledge of the measurement uncertainty, the statement of an analytical result cannot be considered complete. Therefore uncertainty estimation is a chief concern in any fields of measurements. The aim of the present study was to produce a list containing the possible sources of uncertainty for the mass and volume measurement. For an analytical balance readability, repeatability, linearity, off-center loading and hysteresis and for volumetric glassware repeatability, readability, temperature coefficient of sensitivity, temperature scattering, meniscus reading and environmental conditions (temperature and humidity) were considered as the source of uncertainties. Among all, weighing played a crucial role in uncertainty measurements as it is the most important and primary step in any analytical method. The ambient conditions are to be maintained according to ISO standards for performing calibration as the presence of external magnetic field, electrostatic field and evaporation can affect the entire uncertainty measurement.

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**Day 3: 14 December 2019**

**Technical Session-7A: Renewable Energy**

**Session Chair: Dr. Md. Akhtar Uzzaman, SERI, UKM, Malaysia**  
**Venue: ITTI, Room no. 611**

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## Enhancement of hydrogen and volatile fatty acid production by NaOH and cellulase treatment of sweet sorghum stalk in two step dark fermentation

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### Abstract

Efficient co-production of hydrogen and volatile fatty acid from sweet sorghum stalk was developed successfully in two-step dark fermentation process involving alkali and enzyme treatment of the residual slurry after 1<sup>st</sup> step. NaOH concentration was 0.5, 1.0, 1.5, 2.0 and 2.5 % (w/v) for 1 h with temperature of 120, 90 and 60 °C followed by 32 FPU/g-substrate of cellulase treatment on residual biomass were studied. The whole slurry was used without washing after alkali treatment. The optimum severity of treatment for highest yield of products was 2 % (w/v) of alkali at 120 °C along with enzyme loading for 10 g/L of substrate. Two-step fermentation using *Clostridium thermosaccharolyticum* increased production yields by 95 % hydrogen, 97 % acetic acid and 143 % of butyric acid higher than those obtained in single step fermentation. Together these results provide a promising approach to sweet sorghum biorefinery.

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## Potential Biodiesel Production-Using Waste Cooking Oil of Dhaka City; Its Future and Challenge

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### Abstract

The fossil fuel resources are dwindling day by day. The dwindling of fossil fuel resources and the consciousness of the impact of greenhouse gas emissions have created a need to find alternative energy sources to replace traditional ones. The methyl esters of edible and non-edible oils, known as biodiesel are becoming renowned alternative energy source because of their low environmental impact (non-toxic, clean, renewable and biodegradable). In this work high acid value (34.62 mgKOH/g) containing waste cooking oil converted to biodiesel. Amount of solvent, catalyst, temperature and reaction time were optimized for this biodiesel production from waste cooking oil in two-step catalyzed process. In the first step, acid catalyst was used for the esterification reaction to reduce the free fatty acid content in the oil under 2%. The next step base catalyzed transesterification process converted the pretreated waste cooking oil into biodiesel and glycerol in the optimum free fatty acid condition. The highest biodiesel yield was 86.16% with 0.14 % of free fatty acid. The physical properties of waste cooking oil methyl ester known as biodiesel compared with standard biodiesel. FTIR of WCO and WCOME were studied for the confirmation of the conversion.

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## Enhanced production of bioethanol from pretreated waste and biomass

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### Abstract

The global energy outlook is at a deficit comparing the energy production to demand. Challenges such as depletion in fossil fuel reserves, instability in the global oil prices and the enormous environmental threat, contribution to the emission of greenhouse gasses, global warming and climate change are some of the phenomenon associates with the processing of energy sources derived from fossil fuel. The energy drive for the world economy is thus shifting focus from fossil fuels to bioenergy obtainable from renewable sources. Bioethanol is one of the important biofuels used for industrial, medical and transportation purposes. The production of this essential biofuels from renewable biomass and waste is a panacea to over dependent on fossil fuels and by products which are sources of environmental concerns. These lignocellulosic materials are abundant and renewable. They contain the basic sugars that can be utilized to support the growth of organisms that could covert these sugars to bioethanol under anaerobic condition. However, the lignin content possess a big impediment for easy accessibility to these sugars. Application of various pretreatments such as steam explosion, hot water treatment, acid/bade hydrolysis and microwave treatment to these precursor materials is expected to give a boost to the output. Overall, this study aims at providing the optimized conditions for scale up production of this biofuel at industrial scale.

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## Solar cooking Using Phase Change Materials (PCMs)

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### Abstract

Solar energy is the radiant light and heat from the sun that has been harnessed by human since ancient times using a range of ever-evolving technologies. Solar thermal technologies comprise flat collectors for low- and medium temperatures and concentrating sunlight using mirrors and lenses for high temperature. Cooking is an important issue in the world specially developing countries. Only 10%-15% families of Bangladesh get the facility to cook by natural gas. Remaining 85%-90% families cook by conventional method using wood, tree leaf, straw, cow dung etc. As a result greenhouse gas emission increases and causes environmental hazards. The Solar insulation in Bangladesh varies from 3.8 kWh/m<sup>2</sup>/day to 6.4 kWh/m<sup>2</sup>/day at an average of 5 kWh/m<sup>2</sup>/day. These indicate that there are good prospects for solar thermal and photovoltaic application in the country. Solar cooking temperature can be increased 90° to 120°C using flat and inclined type solar collector in Bangladesh. It is enough temperature to cook any food. 2-3 hours time is needed for smooth cooking around 100°C. It is a challenge to maintain constant temperature in cooking chamber as the sun is shaded by cloud or fog in rainy and winter day respectively. The problem can be overcome using heat storage that stores heat energy during the clear sky and release that energy when the



sun shaded by cloud or fog. Phase Change Materials (PCM) can be used to design heat storage. A phase change material (PCM) is a substance which releases/absorbs sufficient energy at phase transition to provide useful heat/coolth. Alpha Nephthol, Glutaric Acid, Methyl Fumarate, Catechol have melting point around 100°C and latent heat 163 (KJ/Kg), 156 (KJ/Kg), 242(KJ/Kg), 207(KJ/Kg) respectively. These PCMs were used to design solar cooker with heat storage. We found that the temperature in the cooking chamber remains around 100°C in case of short time shading of sun.

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## **Facile synthesis of vanadium pentoxide thin film with preferable electrical conductivity as a hole extraction layer for the inorganic thin-film solar cells**

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### **Abstract**

In many research works, vanadium pentoxide ( $V_2O_5$ ) thin-film synthesized through several costly and complicated methods has been generally used as a hole extracting layer (HEL). Here, a simple and low-cost one-pot solution process was used to synthesize the  $V_2O_5$  hole transport layer. From the synthesized  $V_2O_5$  thin-film, the superior optical, electrical and structural properties were found. The optimum carrier concentration of  $\sim 8 \times 10^{21} \text{ cm}^{-3}$  and conductivity  $\sim 4 \times 10^{-1} (\text{W-cm})^{-1}$  were found respectively from the  $V_2O_5$  thin-film annealed at 300°C. The outcomes were better and more favorable than the previous studies on the  $V_2O_5$  hole extracting layer. The synthesized  $V_2O_5$  was introduced in an inorganic thin-film solar cell as a HEL and found a significant improvement in the overall cell performance. Therefore, using such a simple and low-cost method,  $V_2O_5$  thin-film synthesized could be an effective hole extraction layer for the inorganic solar cells.

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**Technical Session-7B: Biotechnology in lignocelluloses**

**Session Chair: Dr. Mobarak H. Khan**  
**Venue: ITTI, Room no. 612**

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## Genetic engineering of jute lignin

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### Abstract

Lignin, a complex, three-dimensional aromatic polymer, serves as a matrix around the polysaccharide components of a plant cell wall by providing additional rigidity, comprehensive strength and hydrophobicity. As a bio-polymeric phenolic macromolecule, lignin is unusual because of its heterogeneity and lack of a defined primary structure. Plants are genetically engineered to produce less lignin so that they would be more suitable for conversion into bio-fuels or high quality paper. Jute, a naturally rich lingo-cellulosic fiber yielding crop, delineates a new promising sphere with respect to lignin manipulation. From an overabundance of experimentations, it is evident that the role of RNAi is immense in gene regulation. Likewise siRNA, artificial microRNA (amiRNA) appends a new prospect in the era of RNAi. Thus this study aimed at designing siRNA and amiRNA based hairpin constructs to introduce into jute by *Agrobacterium tumefaciens* mediated *in planta* transformation in order to develop jute variety with reduced lignin content. The transgenic generations for four genes involved in lignin biosynthesis were analyzed through Southern, RT-PCR and northern assays. As a proof of concept, the decrease in lignin content was estimated (Klason Method) for the transgenic lines and compared with the wild type. The transgenic lines for both strategy viz. amiRNA (C3H-amiRNA & F5H-amiRNA) and siRNA (COMT-siRNA&C4H-siRNA) showed reduced level of gene expression and ~ 16-27 % reduction in acid insoluble lignin content compared to the normal control lines. The results indicate successful amiRNA/siRNA transgenesis in jute, which is likely to have far-reaching commercial implications. Commercial usability of jute is expected to be boosted from a reduction in the lignin content of jute leading to its economic acceleration.

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## Value addition of jute through lignin reduction

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### Abstract

Jute (*Corchorus* sp.), a lignocellulosic annual plant grown abundantly in Bangladesh, is known for its fiber quality. Agro-base, renewable and biodegradable nature together with low-cost availability puts jute at an advantage. Potential high yield of cellulose biomass per acre is another reason for increased global interest on jute. Textile and paper industries are interested in its potential as an important ingredient for producing paper and fine textiles. As with other lingo-cellulosic plants the drawback of jute when used as a source for such purposes is the abundance of lignin polymer that renders the plant material almost inaccessible for downstream processes. A project to down regulate lignin biosynthesis in jute has resulted in significant decrease in the lignin content. In this backdrop, the current study has been performed with a view to evaluating the practical application of the effect of reduced lignin content in industrially important features of jute. The decrease in lignin content is estimated (Klason Method) for the transgenic lines and compared with the wild type which exhibit ~ 16–25% reduction in acid insoluble lignin for the whole stem and ~13–14% reduction in fiber lignin content compared to the control lines. The increase in cellulose content 3-6% is



considered as a consequence of lignin down regulation. The morphological features of the surface of wild type and transgenic fiber observed under scanning electron microscope (SEM) showed clean, fine and a smooth surface of the transgenic fibers compared to control jute plants. Instron tensile testing machine is used to get the tensile properties of the jute fibers which showed that tensile properties of all transgenic fibers are very similar and the breaking tenacity of the fibers is also similar to that of wild type jute fiber. So, from this context, it is expected that lignin reduction in these transgenic plants with effective increase in quality of fiber, increase in cellulose content, and decrease in recalcitrance to glucose release could be suitable if these transgenic jute lines are used for biofuel, paper and pulp as well as for other industrial purposes.

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## Genomic approach to unfold the bast fibre biosynthesis in jute

**B. Ahmed, E. M. Emdad, Q. Md. M. Hossen, R. Ahmed, Md. S. Hossain, S. Md. T. Kabir, R. Hasan, N. Aktar, U. Honi, Md. S. Islam, Md. S. Haque, H. Khan and M. Alam**

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### Abstract

Comparative RNA-seq analysis between fibre cells and seedlings of the two cultivated jute species, *Corchorus olitorius* and *Corchorus capsularis* revealed the key regulatory genes involved in bast fibre formation. Genes encoding PIN1, TDIF, TDIF-TDR and WOX4, proteins are involved in vascular cambium initiation and proliferation, were highly expressed in fibre cells, suggesting their importance in cambium differentiation. Phloem mother cell initiation and secondary phloem fiber formation followed by cambium differentiation were confirmed from the expression of LBD1, APL and HCA2 genes. Loosening and degradation of the surrounding cell wall of a specific secondary phloem fiber cell through the function of NADP oxidase and ROS may trigger the elongation through intrusive growth of that particular phloem fibre cell. HAT 22 and Gibberellin biosynthesis enzymes were directly involved in this specific type of intrusive growth. A substantial increase in expression was observed for MYB83, activates the biosynthesis of major SCW (Secondary Cell Wall) components, cellulose, lignin and xylan. Cesa4 and Cesa7 were upregulated in fibre cells indicating their association with SCW cellulose deposition. Among the lignin biosynthetic genes, there were expansions of the 4-coumarate:CoA ligase (4CL), cinnamoyl-CoA reductase (CCR), trans-caffeoyl-CoA 3-O-methyltransferase (CCoAOMT) and caffeic acid O-methyltransferase (COMT) gene families in jute. Downregulation of major metabolic pathways and upregulation of autophagy and proteolysis pathways through ATG8, suggesting cell death are the final phase of fibre biogenesis. High expression for the enzymes of proanthocyanidin biosynthesis in *C. olitorius*, indicating their involvement for golden colour comparing with the white fibre in *C. capsularis*.

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## Jute endophyte *Grammothele lineata* strain SDL-CO-2015-1 secretome: a great promise for paper and pulp industries

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### Abstract

Endophytes are the endosymbionts that reside asymptotically in plants for at least some parts of their life cycle. Adapting their metabolism to varying carbon and nitrogen sources, endophytes produce an arsenal of extracellular proteins, the secretome which allows for an efficient degradation of cellulose, hemicellulose, lignin and other biopolymers therefore forming potential for exploitation in paper and pulp industries. Jute (*Corchorus olitorius* var 2015) endophytic fungi *Grammothele lineata* strain SDL-CO-2015-1 genome was investigated for such secretory proteins employing different computational tools which revealed a secretome size of 371 of which 108 (29.11%) proteins are CAZymes (carbohydrate active enzyme). This secretory CAZymes includes glycosyl hydrolase families (GH2, GH3, GH6, GH7, GH10, GH11, GH12, GH15, GH18, GH25, GH28, GH30, GH31, GH32, GH35, GH43, GH47, GH53, GH61, GH65, GH71, GH76, GH79, GH92, GH115), auxiliary activity families (AA1, AA2) and cellulase enzymes which are commonly responsible for the degradation of lingo-cellulolytic biomass. Its secretome are also rich in lytic polysaccharide monoxygenase and enzymes for hemicellulose and pectin degradation. Industries are still in need of a single fungal strain capable of producing cellulose enzymes for cost effective processing of wood cellulose for paper and pulp industries. The secretory CAZyme profile suggests *G. lineata* strain SDL-CO-2015-1 as a potential candidate for such applications.

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## Karyological investigation of *Calotropis gigantea* (L.) W. T. Aiton and *Centella asiatica* (L.) Urban: Two important medicinal plants of Bangladesh

C. K. Dash, Md. S. Rahman, M. Afroz and S. S. Sultana

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### Abstract

*Calotropis gigantea* (L.) W. T. Aiton and *Centella asiatica* (L.) Urban have been medicinally used throughout Bangladesh. In this study, karyotypic features of these two species were studied with orcein staining and banding with two base specific fluorochromes such as chromomycine A<sub>3</sub> (CMA) and 4', 6 diamidino-2-phenylindole (DAPI) for authentic cytogenetical characterization. 2n = 22 and 2n = 18 somatic chromosomes were found in *C. gigantea* and *C. asiatica*, respectively. The total chromosome length of *C. gigantea* and *C. asiatica* were 45.35 ± 2.64 μm and 63.63 ± 3.19 μm, respectively. The total form percent (TF%), karyotype asymmetry index (AsK%) and karyotype symmetry index (Syi index) were 47.61, 52.39 and 90.87 in *C. gigantea* and 39.58, 60.42 and 65.51 in *C. asiatica*, respectively. Both species were found to possess 1A karyotype. In *C. gigantea*, 2 CMA- and 4 DAPI-bands were observed whereas *C. asiatica* had 16 CMA- and 6 DAPI-bands. Therefore, the compiled data generated from chromosome analysis on orcein, CMA- and DAPI-banding will be useful for cytogenetical characterization of these two species.

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**Technical Session-7C: Hydrogen Energy Economy**

**Session Chair: Prof. Dr. Mohammad Mizanur Rahman, CUET**  
**Venue: ITTI, Room no. 411**

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## Hydrogen production via biomass gasification and its prospect in Bangladesh

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### Abstract

Hydrogen has been using as one of the green fuel along with conventional fossil fuels which has enormous prospect. A new dimension of hydrogen energy technology can reduce the dependency on non-renewable energy sources due to the rapid depletion of fossil fuels. Hydrogen production via Biomass (Municipal solid waste, Agricultural waste and forest residue) gasification is one of the promising and economic technologies. One of the pilot plant of Biomass to hydrogen is going to be in operation in Bangladesh by 2020. The study highlights the hydrogen production potential from biomass through gasification technology and review the parameters effect of hydrogen production such as temperature, pressure, biomass and agent ratio, equivalence ratios, bed material, gasifying agents and catalysts effect. The investigation also covers the all associated steps of hydrogen separation and purification, WGS reaction, cleaning and drying, membrane separation and pressure swing adsorption (PSA). To meet the huge and rising energy demand, many countries made a multidimensional power development plan by adding different renewable, nuclear and fossil fuel sources. A large amount of biomass (total biomass production in Bangladesh is 47.71 million ton coal equivalent where 37.16, 3.49 and 7.04 MTCE are agricultural, MSW and forest residue based biomass respectively by 2016) is produced from daily uses by a big number of populations in Bangladesh. An efficient conversion of Biomass to hydrogen can save TK. 29873.37 corer that required to import the fuel for the country.

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## Renewable H<sub>2</sub>: a future fuel for transport sector

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### Abstract

The current problems associated with the depletion of fossil fuel reserves and the mounting environmental concerns caused by the use of vast amounts of fossil fuels call for new energy systems to be developed by using renewable fuels. Consequently, renewable fuels such as H<sub>2</sub>, biodiesel, and ethanol are being exploited to promote more sustainable development. H<sub>2</sub> is a clean fuel that emits only water when combusted or used in proton exchange membrane (PEM) fuel cells, and is in growing demand because of the technological advancements made in the fuel cell industry. Unfortunately, 95% of H<sub>2</sub> is currently produced from fossil fuels, causing huge CO<sub>2</sub> emissions. Therefore, much attention has been focused on the production of H<sub>2</sub> from renewable sources. Efforts have gained momentum more recently as the volatility of oil prices and stability of supplies, not to mention the consequences of global climate change, have risen up political agendas the world over. Low-carbon technologies are therefore rapidly advancing, with biofuel, petrol and diesel hybrids, battery electric, and hydrogen fuel cell cars. However, there are two major problems in hydrogen and fuel cells for transport: hydrogen is rarely available to the consumer, while fuel cell cars are too expensive. Both hydrogen availability at filling stations and cheap fuel cell vehicles are needed if breakthroughs are to be achieved. The two main incentives for change, efficiency and zero emission have not been sufficiently valued to date. Zero Emission Vehicle (ZEV) legislation and the overall efficiency of the new vehicles has been disappointing when compared with pure battery and hybrid combustion vehicles, suggesting that the tank-to-wheels efficiency of fuel cell cars might be only about 22% rather than the figures of around 40% suggested by enthusiasts and available from battery electric cars.

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## Clean hydrogen production and carbon capture from power plants via chemical looping combustion

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### Abstract

Chemical Looping Combustion has the inherent properties of capturing carbon di-oxide and Production of pure hydrogen. An integration of Chemical Looping Combustion and Hydrogen Production (CLCHP) is a promising technology for simultaneous carbon capture and production of pure hydrogen. CLCHP is a three steps process in which a suitable oxygen carrier (OCs) is reduced by a fuel, e.g. syngas, partially oxidized by steam and finally oxidised with air. These steps are continued in a cyclic manner and repeated for many cycles. The stability and poor redox kinetics of the oxygen carriers are the major challenges in CLCHP. Fe<sub>2</sub>O<sub>3</sub> is used as the oxygen carrier, however, unsupported Fe<sub>2</sub>O<sub>3</sub> is not suitable for long term cyclic operation as its reactivity degrades rapidly after a few redox cycles. Addition of support materials like CaO, SiO<sub>2</sub> with OCs improve the overall reactivity, stability and decrease the sintering effect. In this study, various Fe-based metal oxide OCs were prepared by the application of wet mixing, ball-milling and co-precipitation methods. The performance of the synthesised OCs for many cycles was investigated in fluidised bed reactor and in a thermogravimetric analyser (TGA) for CO<sub>2</sub> capture during reduction and Hydrogen production during oxidation. Characterizations of these fresh and cycled particles were performed using XRD, chemical analysis and scanning electron microscopy. The addition of Ca and Al in the Fe<sub>2</sub>O<sub>3</sub> results in a significant enhancement of reactivity and stability of the tri-metallic OCs over many redox cycles in looping reaction and realization of H<sub>2</sub> economy.

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## Numerical study of a GaAs<sub>0.92</sub>Bi<sub>0.08</sub> based triple junction solar cell using indigenously developed MSCS-1D simulator

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### Abstract

In this work, a numerical simulation has been performed for an emerging high efficiency GaInP<sub>2</sub>/GaAs/GaAs<sub>0.92</sub>Bi<sub>0.08</sub> multijunction solar cell using our newly developed one dimensional multijunction solar cell simulator (MSCS-1D). This novel simulator has been developed using JavaScript, Bootstrap, PHP and PHP: Security, HTML, JS and CSS programming language. We developed a database-oriented website where both offline and online version of this simulator has been uploaded. The online version of MSCS-1D is available at <https://mscs-bcsir.com/>. As a proof-of-concept, the performance of a triple junction solar cell comprising GaInP<sub>2</sub> as top sub-cell, GaAs as middle cell and GaAs<sub>0.92</sub>Bi<sub>0.08</sub> as bottom cell were investigated using MSCS-1D. All sub-cells used in this combination are in lattice matched condition. The input incident irradiance used in the simulation was 1000 W/m<sup>2</sup> for AM 1.5G. The short-circuit current, open circuit voltage, current density and voltage at maximum power point, fill-factor and efficiency of this multijunction solar cell were found to be 16.32 mA/cm<sup>2</sup>, 2.75 V, 16.16 mA/cm<sup>2</sup>, 2.63V, 0.94 and 42.5% respectively. This simulated efficiency of the GaInP<sub>2</sub>/GaAs/GaAs<sub>0.92</sub>Bi<sub>0.08</sub> solar cell was compared to the efficiencies of this cell reported in the literature and found a good agreement. Moreover, our MSCS-1D performs very fast, precise and user friendly simulation compared to other available simulators.

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**BANGLADESH JOURNAL OF SCIENTIFIC  
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**Technical Session-8A: Renewable Energy**

**Session Chair: Prof. Dr. Nowshad Amin, UNITEN, Malaysia**  
**Venue: ITTL, Room no. 611**

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## Fabrication of $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) thin films by ultrasonic spray pyrolysis at a low substrate temperature and effect of tin concentration on the characteristics of the CZTS thin films

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### Abstract

In this paper,  $\text{Cu}_2\text{ZnSnS}_4$  (CZTS) thin films fabricated on glass substrates using spray pyrolysis method with different concentration of Sn content were studied. To minimize the formation of secondary phases, all the CZTS thin films were prepared at substrate temperature 200°C. Here we show how the variation in Sn content concentration influence the optical and structural properties of the CZTS thin films. The XRD patterns reveal that the concentration of Sn content has to be optimized to minimize the formation of secondary phases at fixed substrate temperature. In turn, band gap of the CZTS thin films are highly influenced by formation of secondary phases. We have found that the films prepared from the precursor solution with 1.8mM Sn content concentration have the best crystal structure and an optical band gap of 1.55eV. The CZTS thin films also have good carrier concentration ranging from  $4.2 \times 10^{19} \text{ cm}^{-3}$  to  $22.9 \times 10^{20} \text{ cm}^{-3}$ .

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## Structural, Morphological, Optical, and Photoluminescence properties of hydrothermally grown ZnO nanorods atop the Al-doped ZnO seed layers

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### Abstract

Preferential *c*-axis oriented ZnO nanorods have been grown on both pure and aluminum (Al)-doped ZnO (AZO) seeded glass and FTO substrates by hydrothermal method. The pure ZnO seed layers were deposited by both drop-casting and spin coating of zinc acetate dihydrate (ZAD) solution on the substrate of interest followed by a post-heat treatment at 250 °C for 1 hour in air. Aluminum chloride hexahydrate has been used as an Al source in ZAD solution for four different dopant concentrations (2, 3, 5 and 8 mole %) to elucidate the physical properties of AZO seed layers. Subsequently, zinc oxide nanorods (NRs) were grown on the property optimized AZO seeded substrates by hydrothermal method and then air-annealed at 250 °C, 350 °C, and 450 °C for 1 hour. XRD patterns for all the samples revealed the formation of wurtzite structure with a predominant reflection from (0002) plane indicating highly preferential growth of ZnO NRs along the *c*-axis. SEM investigation showed the uniform and ordered array of well-faceted ZnO NRs normal to the substrate. Transmission spectra of seed and nanorods were recorded by UV-VIS-NIR spectrometer and the calculated band gap value were found in the range of 3.40 - 3.50 eV and 3.20 - 3.25 eV respectively. The room temperature photoluminescence analyses revealed that nanostructured ZnO films exhibit a sharp near-band-edge luminescence peak at ~380 nm consistent with the estimated optical band gap and the ZnO nanorod arrays are notably free from defect-related green-yellow emission peaks.

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## Characterization of phase pure and oriented Cu<sub>2</sub>O thin films grown by a simple potentiostatic electro deposition technique

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### Abstract

Phase pure Cu<sub>2</sub>O is one of the most desirable p-type absorber materials for ZnO based all-oxide solar cell because of its reported direct bandgap (~2.17 eV) and a suitable band alignment with n-type ZnO electrodes. Highly textured phase pure Cu<sub>2</sub>O thin films have been grown by a simple electrodeposition technique with varying cathodic potentials (-0.3 to -1.0 V) using Fluorine-doped Tin Oxide (FTO) substrates as working electrodes and a carbon rod as a counter electrode immersed in an alkaline aqueous electrolyte held at ~60 °C for 40 min. The surface morphology, structural, optical properties of the as-deposited Cu<sub>2</sub>O thin films were characterized by Scanning Electron Microscopy (SEM), Surface profiler, X-ray diffraction (XRD), Raman spectroscopy, and UV-Vis-NIR Spectroscopy respectively. SEM micrographs revealed that the deposited thin films coherently carpet the underlying substrate and composed of sharp faceted well-define grains having size in the range of 0.5 – 1.0 μm. XRD analyses showed that all films are composed of polycrystalline cubic Cu<sub>2</sub>O phase only and have average crystalline domain size in the range 30 – 73 nm. The preferred crystalline orientation of phase pure Cu<sub>2</sub>O films were found to be changing from (200) to (111) with increasing cathodic potentials and showed highest (111) and (200) crystalline texture coefficient while grown at -1.0 and -0.8 V respectively. The estimated optical bandgap of the as-grown samples were found in the range (2.00 – 2.20) eV consistent with the previously reported results and the variation of the optical bandgap could be attributed to the variation of the film thickness. The performance of copper oxide films was tested by estimating LED 'ON/OFF' modulated surface photovoltage into a photoelectrochemical cell at zero bias voltage and was found to be reasonable to integrate them into optoelectronic devices.

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## Growth and Characterization of Cu<sub>2</sub>O and ZnO thin Films prepared by modified SILAR Method

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### Abstract

Cuprous (Cu<sub>2</sub>O) and Zinc Oxide (ZnO) thin films are the two most studied p- and n-type materials respectively for diverse optoelectronic applications. In this study, both Cu<sub>2</sub>O and ZnO thin films have been grown on soda lime glass (SLG) microscope slides and other substrates by a modified successive ionic layer adsorption and reaction (m-SILAR) using selective precursor solutions. The structural, morphological, optical, and electrical properties of as-grown and thermally treated thin films were investigated by X-ray diffraction, Raman spectroscopy, Scanning Electron Microscopy (SEM), UV-VIS-NIR spectroscopy and



four point collinear probe technique respectively. XRD and Raman measurements confirmed the single phase cubic  $\text{Cu}_2\text{O}$  with (111) preferred orientation and wurtzite  $\text{ZnO}$  with (0002) preferred orientation. SEM micrographs revealed that oxide films uniformly carpet the underlying substrates within the area investigated. The estimated optical bandgaps of  $\text{Cu}_2\text{O}$  and  $\text{ZnO}$  were found in the range (1.99 – 2.40) eV and (3.20 – 3.40) eV respectively with their respective processing parameters. The electrical properties of the as-deposited and annealed samples were found promising for devising solution processable  $\text{Cu}_2\text{O}/\text{ZnO}$  heterojunction.

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## Study of natural dye absorption in $\text{TiO}_2$ and influence of different extraction method on natural dye properties

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<sup>2</sup>*Institute of Energy, University of Dhaka, Dhaka, Bangladesh.*

### Abstract

The performance of dye sensitized solar cells is mainly based on the dye as sensitizer. Natural dyes have become an alternative to highly expensive synthetic dye because it is cost effective, locally abundant and non-toxic. In this work dye was extracted from different types of locally available flower petals. Both dry and fresh petals were dissolved in two different type of solvent for dye extraction. Effects of raw flower petals type and different extracting solvent on the dye properties were studied. UV-Vis spectrophotometer was used to measure the absorbance of natural dye. Also the solvent used for dye extraction has a great influence on absorption spectra of the dyes. We use two types of solvent in this research; one is acetic acid and mixture of acetic acid and ethanol. We found that dye extracted from dry flower petals using mixture of acetic acid and ethanol shows best performance in absorption spectra. The dyes with different concentrations follow the Beer-Lambert law. We prepared  $\text{TiO}_2$  films on glass substrates using spin coating method. The  $\text{TiO}_2$  films show appreciable absorption of dye. Also the structural property of  $\text{TiO}_2$  was characterized using a X-ray diffractometer (XRD).

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**BANGLADESH JOURNAL OF SCIENTIFIC  
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**Technical Session-8B: Genomic Research**

**Session Chair: Prof. Dr. Rakha Hari Sarker, DU  
Venue: ITTL, Room no. 612**

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## Introduction of Human Whole Genome Sequenced-based Research in Bangladesh

Md. S. Khan, Md. A. Habib, S. Akter, T. A. Banu and B. Goswami

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### Abstract

The past few decades have seen significant expansion in genomic research in the advanced economies such as USA, UK and Germany. By deploying the benefits of contemporary technological advancement, genomic research has gradually emerged as a distinct discipline where likeminded biologists, computer scientists and statisticians assemble together to approach known and novel biological problems. In particular, the application of next-generation sequencing (NGS) technologies on human genome in research and clinical settings has increased dramatically in recent years. While these countries have flourished in developing and adopting cutting edge facilities, strategies and technologies, such initiative was almost non-existent in Bangladesh. Recently, the analysis of the whole genome sequencing of 22 Bangladeshi Breast Cancer Patients has been started by analyzing the whole genome of NovaSeq (Novaseq-6000), the world's most advanced NovaSec (6000) machine installed at BCSIR. Whole Genome Sequencing of all organisms can now be done with the benefits of this established laboratory.

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## A recombinant protease propeptide is able to inhibit the proteolytic activity of *Porphyromonas gingivalis* pathogenic isolates with global origins

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### Abstract

Chronic periodontitis is a destructive inflammatory disease that involves alveolar bone resorption and can cause tooth loss. More significantly this chronic inflammatory disease is now known to be associated with comorbidities including rheumatoid arthritis, low infant birth weights and atherosclerosis. The disease is associated with dysbiosis of the dental plaque biofilm, with *Porphyromonas gingivalis* considered a keystone pathogen. *P. gingivalis* produces many virulence factors of which the cysteine proteases the Arg-gingipains (RgpA, RgpB) and Lys-gingipain (Kgp) are considered most important. Inhibitors of these proteases have been devised, however none are ideal, being non-specific or toxic or both. The gingipain nascent polypeptides are produced with N-terminal propeptides that render them inactive until they are cleaved at the cell surface. We recently demonstrated recombinant proteins mimicking the RgpB and Kgp propeptides were able to inhibit purified RgpB and Kgp respectively and also reduce whole bacterial cell proteolytic activity, whilst not inhibiting host proteases. In this study we tested a recombinant RgpA propeptide demonstrating inhibition in the nanomolar range. Furthermore, we show that this propeptide is able to inhibit Arg-gingipain activity in *P. gingivalis* strains that have been collected from around the world. Therefore gingipain propeptides show promise as specific, non-toxic therapeutics for the treatment of *P. gingivalis*-associated chronic periodontitis.

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## Genomic DNA of *Streptococcus pneumoniae* activates both Th1 and Th2 pathways and protect mice against live cell challenge

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### Abstract

Immunogenicity of the genomic DNA extracted from *Streptococcus pneumoniae* was evaluated in this study. Genomic DNA of serotype 7F was extracted and injected into a group of twelve Swiss Albino mice three times at six weeks intervals by the intramuscular route. All mice were challenged two weeks after the last injection with live *S. pneumoniae* (approximately 10<sup>6</sup> cells, intra-peritoneal route) and observe for sixty days. All mice immunized with the genomic DNA survive with the challenge experiment, whereas, all control mice without any immunization died within 21 days after the live cell challenge. Antibodies elicited by the DNA immunized mice were shown to be reactive to certain outer membrane proteins by Elisa and the immune-blot technique indicate a strong humoral response. The DNA receiving mice showed increased production of NO (nitric oxide) and a high expression of CD4<sup>+</sup> and CD8<sup>+</sup> T cells. Splenic cell of immunized mice shows specific proliferation in response to the stimulation with *Streptococcus pneumoniae* genomic DNA and also produced IFN- $\gamma$  and IL4 after 12 hours and 48 hours, suggesting the induction of a mixed Th1 and Th2 response. These results suggest that the genomic DNA could be an excellent candidate for use in future vaccination studies against infections including pneumonia caused by *Streptococcus pneumoniae*.

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## Prevalence & characterization of antibiotic resistant pattern of *E. coli* in waste water from Chattogram city, Bangladesh

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### Abstract

Antibiotic resistance is a great threat for whole world specially for developing countries like Bangladesh. In 2014, United Kingdom government has estimated that 10 million death a year by 2050 might be occurred due to antimicrobial resistance problem. Antibiotic resistance data for only six districts are available among 64 districts of Bangladesh. We collected waste water samples from 16 locations of Chattogram city. A total of 110 *E. coli* has been isolated and identified by using different selective media and Biolog microbial identification system. Antibiotic sensitivity test was done by Kirby Bauer disc diffusion assay. We used 16 antibiotics against the isolates. CLSI breakpoint guidelines were used to interpret the results. It is a matter of great concern that 38.89% isolates were found as multidrug resistant. Isolated *E. coli* strains showed the highest resistance against Ampicillin (68.18%), Amoxycillin-Clavulanic acid(52.73%) and Trimethoprim-sulfamethoxazole (34.55%) compared to other antibiotics. On the other hand, isolates are also becoming resistant against Streptomycin (19.09%) & Piperacillin-Tazobactam (18.18%). *E. coli* isolates showed the highest susceptibility against Meropenem (97.27%).

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## Karyotype analysis and report on B-chromosome in *Gloriosas uperba* L. by differential staining

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### Abstract

In this investigation *Gloriosa superba* L. was cytogenetically studied with orcein, CMA and DAPI-staining for authentic characterization. “Complex Chromocenter Type” of interphase nuclei with 3–4 bigger darkly stained heterochromatic regions were found in this species. The prophase chromosomes were “Interstitial Type” with darkly stained region at different interstitial sites of chromosomes. This species had  $2n = 22$  chromosomes with heterogenous centromeric formulae  $14m + 8sm$ . In addition to the regular chromosomes, 1–6 small chromosomes were found in several mitotic pro-metaphase, metaphase and anaphase stage which covered 43.57% of the total cell count of this species suggesting the probable occurrence of B-chromosome. Presence of B-chromosome was probably the first report for this genus. After fluorescent banding, a pair of dot like CMA fluoresced bands were observed whereas no bright band was found in *G. superba* after DAPI-staining which suggested the coexistence of GC- and AT-base pairs in the genome. Thus, the compilation of the above information will be very useful for cytogenetical characterization of *G. superba* L. in Bangladesh.

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## Application of genomic tools for genomic improvement of crossbred Friesian cattle in Bangladesh

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### Abstract

Bangladesh is known for its huge livestock population and is estimated to have 24.2 million heads of cattle, about 80 % of the total cattle in the country are local breeds; the remaining are cross breeds (DLS, 2019). Although cattle population size in Bangladesh is satisfactory but their productivity is low as compared to its potentiality and also as compared with exotic dairy animals; contribution to the Bangladesh economy is very limited, production per animal is not sufficient enough. Productive and reproductive traits are crucial factors determining the profitability of dairy production. In Bangladesh, productive and reproductive performance and poor genetic merit of cattle are considered as the major constraint against growth in dairy industry. Genetic improvement has accrued through breed substitution, cross- breeding and within- breed selection. It has increasingly relied on sophisticated statistical methods, including mixed model methodology, to provide ever more accurate individual estimated breeding values (EBVs). Spectacular genetic improvements have been achieved in several species by combining within- breed selection with reproductive technologies (such as artificial insemination and embryo transfer) to more effectively disseminate elite genomes. Estimation of genetic parameters i.e., heritability and genetic correlation is the pre-requisite for the assessment of genetic worth of animals. Considering the above mentioned facts, it is important to identify the best crossbred Friesian dam and sire with respect to performance traits using genomic tools for improvement of dairy sector Bangladesh. One thousand adult crossbred Friesian cows will be randomly selected and tagged for identification in four divisions namely Dhaka, Chattagram, Mymensingh and Rajshahi in Bangladesh under farmer’s and Government



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managemental system. Phenotypic data will be collected from all selected cows once in a month by interviewing with structured questionnaire for 2.5 years. Fifty nondescript local zebu cows will be selected and phenotypic data will be collected to use as control data. Phenotypic data will also be collected from twenty breeding bulls routinely used for artificial insemination (AI) in Central Cattle Breeding and Dairy Farm, Savar, Dhaka. One blood sample (~10 ml) will be collected from all the selected animals in anticoagulant coated tube. DNA will be extracted using commercial DNA extraction kit following instruction of manufacturer. DNA will be analyzed by using low density single nucleotide polymorphism (SNP) array following standard protocol to detect the parentage and admixture of genome in crossbred Friesian cattle to relate with the performance data (productive and reproductive performance) which reveal to identify the best crossbred Friesian dam and sire for future selection of sires to be used for AI in Bangladesh.

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## Single nucleotide polymorphisms in Beta-casein gene in cattle in Bangladesh

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### Abstract

Milk is considered as most nutritious, perishable and nature's almost complete food. However, consumption of dairy products reported to play a role in the development ischemic heart disease, insulin dependent diabetes, atherosclerosis, schizophrenia, infant sudden death syndrome, gastrointestinal dysfunction and immune/inflammation related disorders, etc.  $\beta$ -casomorphine-7 (BCM-7) derived from digestion of A1 milk in human intestine is attributed as responsible agent. It can potentially affect numerous opioid receptors in the cardiovascular, respiratory, nervous system and immune system in human. It is reported that the populations consume A2 milk have a lower incidence of cardiovascular disease and type-1 diabetes. Classification of A2 or A1 milk is based on  $\beta$ -casein gene variants. A2  $\beta$ -casein is recognized as the original  $\beta$ -casein protein because it existed before a mutation caused the appearance of A1  $\beta$ -casein in European cattle (*Bostaurus*) a few thousand years ago. The difference between A2 & A1  $\beta$ -casein variants is a single nucleotide CCT to CAT which alter amino acid proline to histidine at 67<sup>th</sup> position of  $\beta$ -casein peptide chain. Present research focuses to determine genetic polymorphism in beta-casein gene of cattle in Bangladesh in terms of A1/A2  $\beta$ -casein. A total of 549 blood samples were collected from different regions of the country. Of these, 280 samples were derived from local and 269 from crossbred animal. DNA was extracted from blood and tested by polymerase chain reaction (PCR) with allele specific primer or PCR followed by restriction fragment length polymorphism (PCR-RFLP). Of the tested samples, 26.23% samples were found homozygous A2A2 (A2 milk producer), 65.57% heterozygous A1A2 (Mixed A1A2 milk producer) and 8.20% homozygous A1A1 allelic (A1 milk producer). Among the tested crossbred and local animals 27.88 and 24.64% samples were found A2 milk producer, respectively and 8.92 and 7.50% A1 milk producer, respectively and 63.19 and 67.86% were found A1A2 milk producer, respectively. A2 gene (0.6) was found to dominate A1 (0.40). However, only A1 milk producer animal is also available.

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## Genetic effects of *Leptin* receptor (LEPR) polymorphism on litter size in the Black Bengal goat population

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### Abstract

Leptin receptor (LEPR) is involved in central signaling for both the energy homeostasis and reproduction. The present study investigates the association of the LEPR gene with the prolificacy of Black Bengal goat. Two single nucleotide polymorphisms (SNPs) (g.104911A>G and g.104976 A>G) in intron 3 and one SNP (g.105151 A>G) in exon 4 in LEPR gene were identified with pooled DNA sequencing. The identified SNPs were genotyped by direct sequencing method from 84 Black Bengal does. Polymorphism g.105151 A>G was found in exon 4 as synonymous mutation (Lysine > Lysine). The effects of the genotypes on litter size traits were estimated within the stages using linear models in the procedure PROC GLM in SAS. Our result showed that goat with heterozygous genotype AG at g.104911A>G and g.105151 A>G locus showed highest prolificacy performance ( $P < 0.0001$ ), among other homozygous genotypes at any of the loci except g.104976 A>G. Dominance and additive effects were observed at locus g.104976 A>G and g.105151 A>G, respectively. No significant allele substitution effects were found for any locus. Our results preliminarily indicated that *LEPR* may have some association with prolificacy and could be a candidate gene to improve the prolificacy traits in goat.

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