

Introduction

Bangladesh's Scientific and Industrial Research Council (BCSIR) is the country's largest and most diverse multi-faceted science and industrial research organization. In the year 1955, then the Eastern Laboratory Dhaka was established. in order to achieve the socio-economic development of the country through successful application of scientific research and innovation. Later, in 1965 BCSIR laboratory was established in Chittagong and in 1967, the BCSIR laboratory Rajshahi was established. After independence Father of the Nation Bangabandhu Sheikh Mujibur Rahman established the Bangladesh Council of Scientific and Industrial Research (BCSIR) in 1973 to form a knowledge-based, developed Bangladesh through implementation of sustainable and appropriate technology. On October 10, 2013, the Bangladesh Science and Industrial Research Council Act were approved by the Parliament.

BCSIR has expanded its domain to three full-fledged multi disciplinary regional laboratories, five mono disciplinary institutes and one pilot plant studies centre which are carrying out research and development (R&D) programs in different fields of science and technology to develop and transfer of new technology. BCSIR is also mandated to offer analytical services to solve various fundamental and applied problems faced by the industries, different public and private organizations and entrepreneurs.

Vision:

Acquired the Center for Excellence in Science and Technology.

Mission:

To assist in the industrialization and development of the country by establishing international laboratories, creating skilled manpower, inventing and developing technology.

BCSIR has a network of 12 laboratories, institutes and centers.

BCSIR units:

- BCSIR Laboratories, Dhaka.
- BCSIR Laboratories, Chittagong.
- BCSIR Laboratories, Rajshahi.
- Institute of Fuel Research & Development (IFRD), Dhaka.
- Institute of Food Science & Technology (IFST), Dhaka.
- Pilot Plant & Process Development Center (PP& PDC), Dhaka.
- Institute of Glass and Ceramic Research & Testing (IGCRT), Dhaka.
- Leather Research Institute (LRI), Savar, Dhaka.

- Institute of Mining, Mineralogy and metallurgy (IMMM), Joypurhat.
- Designated Reference Institute for Chemical Measurements (DRICM), Dhaka.
- Institute of National Analytical Research and services (INARS), Dhaka.
- Institute of Technology Transfer and Innovation (ITTI), Dhaka.

In order to increase the institutional capacity Eight Annual Development Programs (ADP) are being implemented in the year 2017-2018 at BCSIR.

The projects are:

1. Establishment of Physical Facilities for Technology Transfer and Innovation of BCSIR
2. Strengthening of Leather Research Institute
3. Capacity Building of IFST for Research on Milk and Dairy Products
4. Establishment of Mineral Processing Center at IMMM of BCSIR
5. Establishment of Institute of Bio-equivalence Studies and Pharmaceuticals Sciences
6. Establishment of Genomic Research Laboratory
7. Augmentation of Chemical Metrology Infrastructure
8. Strengthening of Institute of Glass and Ceramic Research and Testing (IGCRT) of BCSIR

Innovation Gallery

In order to showcase the products and processes of BCSIR, the largest multidisciplinary research organization in the country, an innovation gallery has established at its main campus in Dhaka. Through this initiative, a facility has been created to demonstrate the invention and innovation of scientists and engineers of BCSIR to entrepreneurs, students and mass people of the country. Entrepreneurs can have an easy access to the technologies from different laboratories of the organizations in a single point and acquire the technical and technological support for helping industrialization and job creation in the country.

Establishment of Central Laboratory

A central laboratory well equipped with ICPMS, AAS, GCMS, PCR, DNA Sequencer and many other world standard and state of the art equipments has been established in the main campus of BCSIR in Dhaka. Almost all the necessary equipment for providing chemical analysis and testing services are present in the laboratory. As a result, clients who seek such service from BCSIR can get them from a single point easily. Moreover, scientists from

different laboratories can share these precious instrument and get their sample tested from this central laboratory. To ensure the best use of the instruments and reduce the wastages of time, cost and chemicals, this laboratory will play a pivotal role. Duplication of sample instruments at different laboratories will also be reduced through this initiative.

International and National Memorandum of Understanding (MoU) of BCSIR

BCSIR has signed memorandum of understanding with different national and international organization as a part of its venture to create mutual cooperation in the field of research and development. Among the international organizations, The Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia, The Council of Scientific and Industrial Research (CSIR), India and Japan Development Corporation (JDC) are mentionable. National pertinent organizations like Small and Medium Entrepreneurs Foundation (SMEF), Bangladesh Livestock Research Institute (BLRI) have signed MoU with BCSIR for mutual cooperation to promote and disseminate technology developed by BCSIR for the benefit of the people of the country. Partnerships with international and national organizations in the field of technology development and exchange for their effective application for the wellbeing of people have been created through these MoU within and outside the country.

Collaboration with international research organizations has created a scope for BCSIR to do research, technology development, transfer and apply the developed technologies for industrialization in our country. Additionally, following windows of cooperation have been opened up through these MoU:

- Conduct joint research
- Technology transfer
- Manpower development through subject-specific training
- Exchange and share knowledge by organizing and attending to scientific seminar, workshop etc.

BCSIR Laboratories, Dhaka

BCSIR Laboratories, Dhaka was established in 1955 bearing the name of East Regional Laboratories under the erstwhile PCSIR as a multidisciplinary research establishment. This laboratory is dedicated to conduct both basic and applied research to foster scientific and industrial development through innovation. BCSIR Laboratories, Dhaka's R&D expertise and experience is embodied in about 62 active scientists supported by about 74 administrative and technical personnel. The laboratory focuses its research and development in the areas of Biology, Chemistry, Fiber and polymer, Industrial physics, Pulp and paper, Physical instrumentation as well as Pharmaceutical by seven research divisions. In addition to R&D activities, the scientists are also engaged in providing analytical and testing services to various public and private bodies, entrepreneurs and individuals. BCSIR Laboratories, Dhaka also provides opportunities for the students of different universities to learn more about science and scientific research through thesis guidance and fellowship program. This unit plays a key role to support government's programmes through proper research direction that is aligned with the country's priorities along with BCSIR mandate and its science and technology competences.

Biological Research Division (BRD)



DECORATE YOUR LIFE WITH BIOTECHNOLOGY

Biological research division is the largest division in BCSIR laboratories, Dhaka which conducts research and development activities in the field of Biological science in the following sections:

- **Applied Botany:** Research on economically important algae, fungus, medicinal, horticultural and flowering plants culture and always serving the lease entrepreneurs which are commercially producing and marketing *Spirulina* in the form of tablet, capsule, powder, drinks etc.

- **Soil and Environment:** Conduct research on soil health improvement, fertilizer product development, fertilizer quality control, digital soil information system development through GIS technology, air pollution monitoring and mitigation, reclamation of contaminated soil and waste water, environmental impact assessment of different industrial area and economic zones etc.
- **Tissue Culture:** *in vitro* plant regeneration and multiplication of important medicinal, fruit, flower, natural dye producing and timber plants. To carry on genom & molecular research for disease free on different plants.
- **Plant Pathology:** Isolation, identification and characterization of bioactive metabolites from endophytic fungi and find out the plant diseases caused by fungus and bacteria and their remedy by biological means.
- **Plant Physiology:** conducts research on plant hormones, different levels of macro and micro elements and biochemical activities of different vegetables.
- **Zoology:** applied research on entomology (insect taxonomy and pest management) and fisheries (ornamental fish, live fish feed culture and artificial fish feed formulation and evaluation).

Research & Development (R & D) Activities:

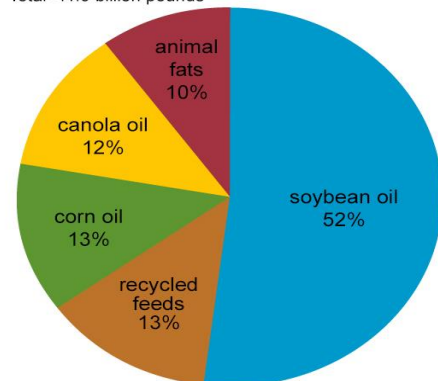
Cultivation of Different Species of Algae with High Lipid Content to Produce Bio-fuel in Commercial Scale.

In recent decades the rising demand of global energy is heavily dependent on fossil fuel including coal, natural gas and petroleum. However, it is predicted that the supply of fossil fuel will come to an end by 2050 considering a 5% flat increase in demand.

In addition, excessive use of fossil fuel is causing an increase of greenhouse gas CO₂ in the atmosphere, which is considered responsible for temperature increase, sea level rise, deviation of biodiversity and ecological imbalance. Therefore, many developed and developing nations are conducting extensive research programs to explore future generation fuel which will be greener, cleaner and renewable. Biodiesel is non-toxic, water soluble, quickly biodegradable and CO₂ neutral.

Feedstock inputs to U.S. biodiesel production, 2017

Total=11.9 billion pounds



Source: U.S. Energy Information Administration (EIA), *Monthly Biodiesel Production Report*, March 2018

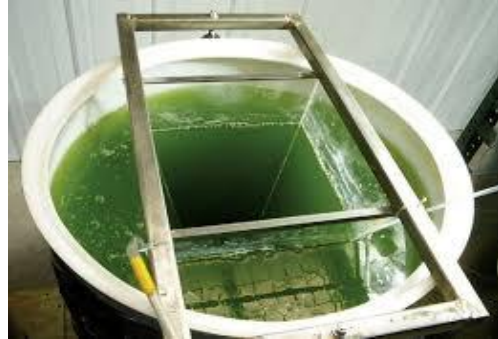


Objectives:

- Using biodiesel in place of gasoline helps to reduce CO₂ emissions by an average of 34%.
- Biodiesel production from algae has drawn the most attention because of its eco-friendly potential of high productivity.

- The prospect of producing biodiesel from algae has been growing, since it yields 30 times more energy per acre than land crops as soybeans.

Progress Achieved: The 2nd & 3rd batches cultures have already been done. Next Year, extraction will be done to produce biodiesel.



In the meantime already achieved: International Conference on Petroleum Engineering 2016 (ICPE-2016) Bangladesh University of Engineering & Technology (BUET) Dhaka-1000, Bangladesh. **ICPE – (051). Title:** Studying Growth Kinetics of *Chlorella vulgaris*, a Microalgae with High Lipid Content, to Produce Biodiesel in Local Condition. Journal of Nature Science & Sustainable Technology (Accepted).

Industrial pollution: levels and types of heavy metals entering into food chain (soil-water-plant continuum) from different industries in and around Dhaka city.

Most of the industries in Bangladesh have no Environmental Management Plan (EMP) and discharge their wastes and effluents in to the environment without proper treatment which cause soil, water and air pollution. This research was undertaken to assess the impact/risks of heavy metal toxicity on human health from contaminated soils, water bodies and ecosystem receiving the industrial wastes and effluents.

Objectives:

- To determine & quantify the amount of heavy metals in wastes discharged from different industries in and around Dhaka city and their respective entrance into food chain through the soil-water-plant continuum.
- To find out the response of different plants (vegetables) on the uptake of different heavy metals from plant growth media (soil).

Progress Achieved:

- Four (04) papers has already been published (two more scientific papers are almost ready for submission).

Production of humic substances (humic acid, fulvic acid) from indigenous sources for the reclamation of contaminated soil and waste water.

Since heavy metals are generally strongly bonded to soil, removal of heavy metals requires harsh chemicals such as strong mineral acids or powerful complexants. The use of strong acids is soil destructive and EDTA is also toxic when persistent in the environment. Soluble humic substances (HS) might be used instead of these synthetic chemicals. Due to the content of carboxylic acid and phenolic groups, humic substances possess ability to form complexes with di- and trivalent metal cations. 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.

Objectives:

- Isolation, extraction and characterization of humic substances from different indigenous sources
- Determine the interaction of contaminants with humic substances as natural chelating agent.
- Treated waste water by humic substances as natural coagulants.
- Carry out several *in situ* and *ex situ* chemical extraction and immobilization techniques particularly by humic substances for the reclamation of contaminated soils and waste water.

Progress Achieved:

The level and distribution of heavy metals in soil and waste water was determined using ArcGIS contour mapping system.

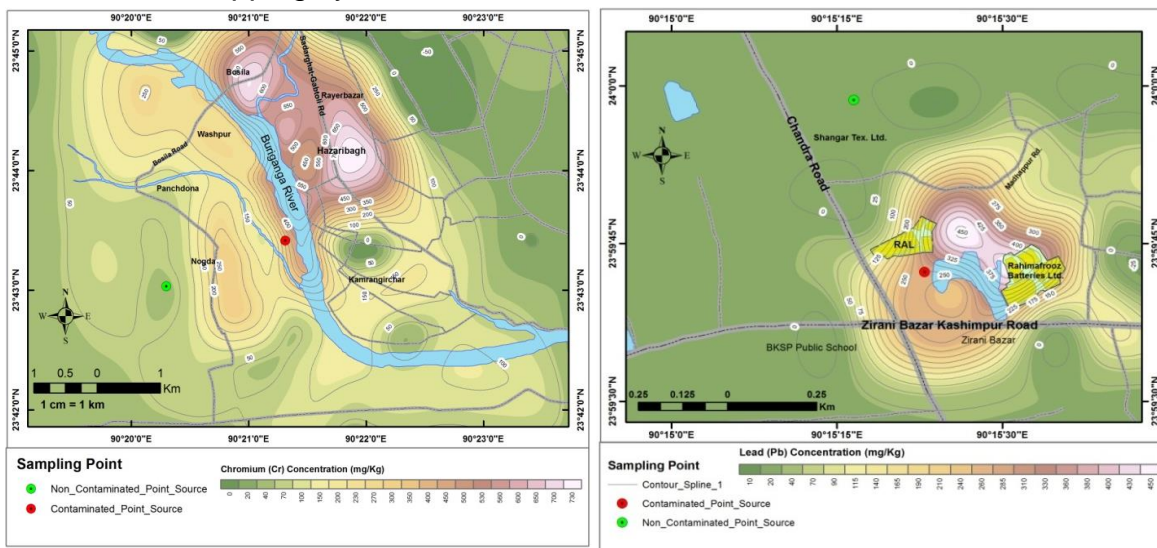


Figure: Contour line representing the level and distribution of Cr and Pb in Hazaribagh tannery and Ziranibazar battery industries, respectively.

- Humic substances was used to remediate metal contaminated soils through leaching technique.
- Pot experiment was conducted to determine the mobility and bioavailability of metals from treated soil to plant.



Figure: Collection of leachate from contaminated pots after extraction with HS



Figure: Rice plant (BRR1 dhan 49) grown in humic substances treated soils.

Rational Design and Synthesis of various morphology of titanium dioxide (TiO₂) and its application on Environment.

TiO₂ is the most important metal oxides which used for multidimensional application. It has some intrinsic properties which play the key role for application point view. Environment and human life are inextricably linked and all living being depends upon environment which one of the prime SDG goal to implemented the present governments. Government has undertaken integrated policy and plan to protect the country from environment pollution and protect the water resources as per pledges made in the election manifesto. Various morphology of TiO₂ has intrinsic properties and also versatile application for degradation of various environmental pollutants (4 Chlorophenol and Methylene blue).

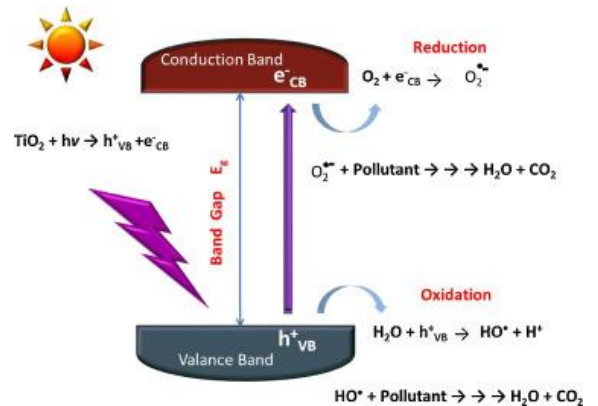


Fig : Schematic Illustration of waste water treatment under ambient condition.

Under ambient condition industrial waste water monitoring clearly indicate that as synthesize catalyze are highly effective for degradation of dye molecule.

Waste water degradation of Industrial waste under open sunlight



Development of biochar products to reduce greenhouse gas emission and decrease arsenic and heavy metals phytoavailability in contaminated soil.

Instead of removing, burning, dumping or land filling of waste materials, it can be returned to the soil as biochar that acts as a soil ameliorant and holds arsenic and other heavy metals. Biochar also increase crop yield and enhances soil quality and health. Carbon in biochar can persist in soils over long time scales. Beyond the carbon sequestered in the biochar itself, biochar incorporated in soils also offers numerous other potential climate benefits. Biochar can reduce emissions of nitrous oxide (N₂O) and methane (CH₄)—two potent greenhouse gases—from agricultural soils

Objective:

- To produce biochar from different organic wastes at different temperature.
- To characterize biochar products (Surface area, Cation exchange Capacity, Structural Evaluation, Carbon content etc)
- To reduce green house gas emissions by applying biochar in soil.
- To reduce the mobility and bioavailability of arsenic and other heavy metals into plant by applying biochar products.

Progress achieved

- Biochar products were developed from indigenous sources at different temperature.
- Characterization of biochar products (surface area, structure, pore volume, pore diameter, cation exchange capacity, carbon content) was performed.
- A paper entitled “Arsenic mitigation approach in soil by some indigenous sources of biochar of different pyrolysis temperature” has already been published from this project.



Fig: Monitor the emission of gases from experimental pots with or without applying biochar products in a green house system.

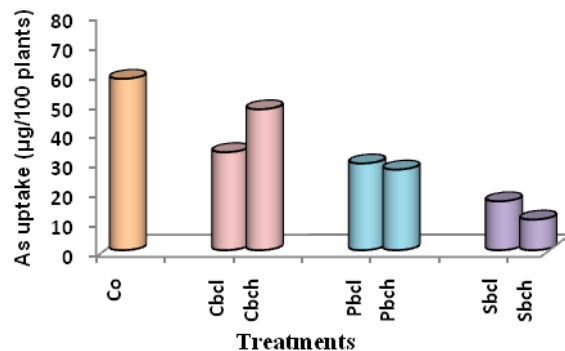


Fig : Arsenic accumulation by Kalmi plant grown in biochar treated soils

Isolation and identification of indigenous fungi for the bioremediation of dye effluents.

Synthetic dyes are extensively used in the textile industries. Direct discharge of these effluents contains toxic aromatic compounds. Different species of fungi *Aspergillus fumigatus*, *Aspergillus niger*, *Cladosporium*, *Pleurotus ostreatus* are capable of decoloring and removing these dye effluents and keep our environment free from pollution. It will be a cost effective and environment friendly process.

Objectives:

- To isolate and identify the indigenous fungi from different sample (soil, water and plant)
- To examine the degradation efficiencies of the isolated fungi.
- To identify the enzymes for dye degradation activity through biotechnological approaches.
- To evaluate the mechanism of biodegradation process of dye effluents.

Progress Achieved: The dye effluent was collected from the EPZ area. From the collected samples different micro-organisms are isolated by serial dilution method. Isolated fungi were identified up to genus level based on morphological character and microscopic observation. Fungi were *Penicillium* sp., *Aspergillus niger*, *Cladosporium* sp. etc. An experiment was conducted for the Methylene blue dye degradation.

Development of Culture Technology for Insect larvae as Live Fish Feed.

Food security is a global challenge. As overall demand for food particularly meat increases, there is an urgent need to increase supply of protein from sustainable sources. Insects, especially flies, have the potential to help meet this demand. As fly larvae is a natural component of the diet of fish, chicken and pig, the proposed research is focusing on rearing two species of fly (for example, house fly and black soldier fly) and conducting feeding trials with their larvae or maggots. Fly larvae grown on a range of organic wastes have the ability to reduce the volume of that waste by up to 60%, providing an additional benefit to waste management and the environment. The present research will evaluate the quality and safety of the larvae produced for incorporation into fish feed, as well as the taste and texture of the meat produced.

Objectives:

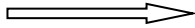
- ❖ To develop mass culture method for insect larvae (i.e. Diptera larvae) as live fish feed.
- ❖ Further research on introduction of a new diet, development of culture method of insect larvae through organic waste management system.
- ❖ Investigate on high yielding varieties of insect which is suitable for commercial culture and improvement of indigenous insect larvae by crossbreeding.

Progress Achieved:

- Culture method of house fly larvae and black soldier fly larvae was established.
- Growth performance and nutritional value of these larvae as fish feed is trying to develop using different culture media.



Black Soldier Fly larvae



Black Soldier Fly

High yielding bulb size with strong pungent aroma of *Allium cepa* L. at early harvest as influenced by plant growth regulators and organic fertilizer (Blood meal).

Onion (*Allium cepa* L.) is generally a biennial plant but grown as an annual which is belongs to Alliaceae family. It is an important spice crop, cultivated all over the world. It has also preservative and medicinal values (Vohra *et al*, 1994). It is rich source of calcium, riboflavin and carbohydrates. The annual onion requirement of Bangladesh is about 4,80,000 m.tons and the total onion production is about 1,27,000 m.tons (BBS, 2001), a shortage of 3,53,000 m.tons per year has been prevailing in our country. For this reason, to fulfill the demand of our growing population, a significant number of onion is imported per year. By increasing production of onion, government can be fulfill the demand of spice crop onion as well as it may be exported.

Objectives:

- Observation of yield and yield attributes vegetative growth with hard pungent aroma.
- To observe the effect of plant growth regulators on plant development.
- To reduce the use of chemical fertilizer and to maintain the soil originality.

Progress Achieved:

- Uniform seedlings (45 days old) of the onion varied BARI peaj-1 were collected from Spice Research Center in BARI.
- A field experiment was conducted at the experimental field of BCSIR to see the effect of plant growth regulator (GA3), Blood meal and Urea on Onion production.
- 1st year experiment has been completed successfully. All the data has been collected and data analysis is going on.

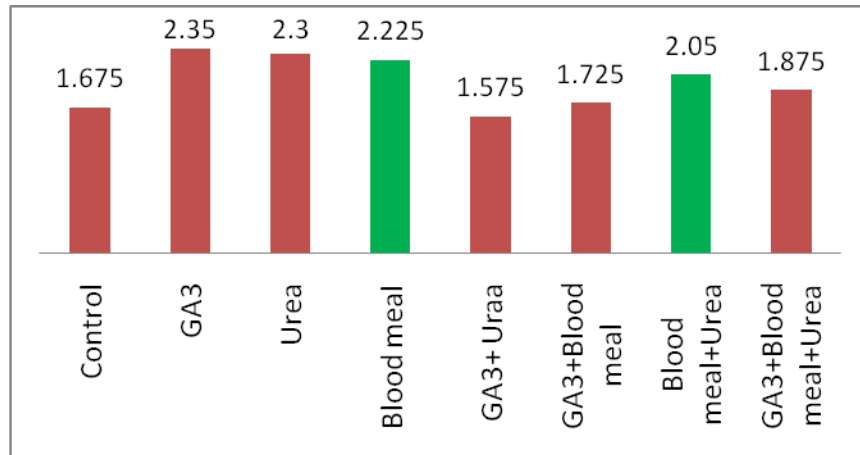


Figure: Yield of fresh bulb of onion (kg/36ft² plot)

***In Vitro* regeneration and molecular characterization of some varieties of *Brassica sp.* in Bangladesh**

Brassica sp. is an important oil seed crop in our country. For improvement of this crop through biotechnological approach it is essential to develop a suitable and reproducible regeneration protocol for locally available varieties grown in Bangladesh. Molecular markers have become important tools in studying genetic diversity.

Objectives:

- To establish a suitable regeneration protocol by comparative analysis of the different growth hormone compositions in some *Brassica campestris* varieties.
- To characterize the *Brassica campestris* varieties by using Random Amplified Polymorphic DNA (RAPD) markers. Determine the phylogenetic relationships among the *Brassicacampestris* varieties on the basis of molecular data.

Progress Achieved:

- Efficient regeneration protocol has been established of some important *Brassica varieties* grown in Bangladesh.
- Most of the cases MS medium supplemented with BAP (mg/l) and IAA (mg/l) showed best regeneration response.
- PCR analysis was going on using the RAPD primers.



Fig: Different stages of regenerated multiple shoots from leaf explants on MS media with different hormone.

High efficiency regeneration of *Gynura procumbens* (Lour.) Merr. an important medicinal plant and identification of its active compounds through NMR profiling.

Gynura procumbens (Lour.) Merr. is an important medicinal plant for diabetes patient in South East Asia. Due to the wide application of this plant in traditional medicine, a number of studies should conduct for the investigation of different pharmacological activities. The regeneration protocol is useful for large-scale clonal multiplication as well as for transformation studies. Moreover *in vitro* cell and tissue cultures will be used for the production of secondary metabolites,

Objectives:

- Development of an efficient system for the regeneration of *G. procumbens* from various explants.
- Determination of chemical properties and comparative studies among callus, tissue culture and field grown plant parts.

Progress Achieved: Successful plant regeneration was found from nodal segment, leaf and petiole explants of *Gynura procumbens* plants. Among the three explants best response (22.2) shoots/ explant was recorded from petiole explant on MS media supplemented with 2 mg/l BAP, 0.5 mg/l Kn and 1.0 mg/l IAA. Adequate number of shoots produced roots on half strength of MS medium and the plant were survived properly in soil. Callus was produced spontaneously on MS medium with 3mg/l 2,4-D on also tried from other explants such as leaf, petiole etc.

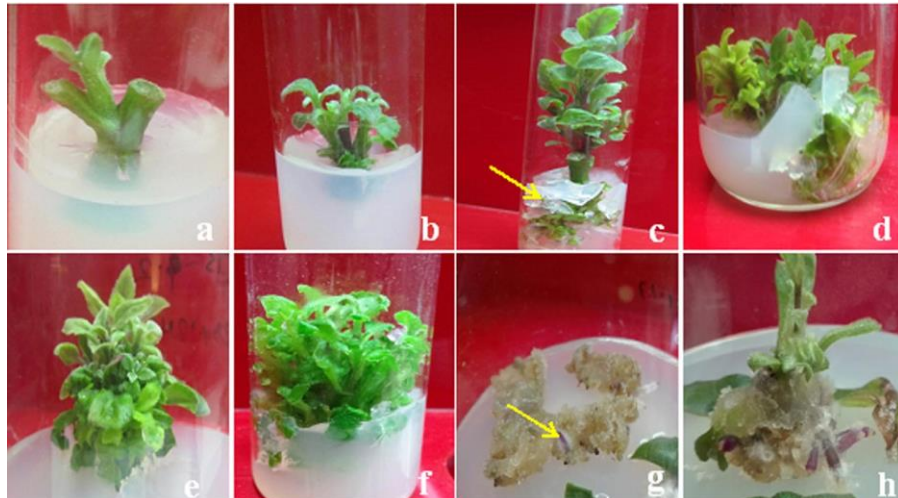


Fig: Different stages of multiple shoots regeneration and callus formation from different explants of *Gynura procumbens*.

Qualitative and quantitative determination of bioactive metabolites in field grown plants, *in vitro* grown plants and callus tissues obtaining from *Rauwolfia serpentina* L. and *Bacopa monnieri* L.

Natural products, such as plants extract, either as pure compounds or as standardized extracts, provide unlimited opportunities for new drug discoveries because of the unmatched availability of chemical diversity. Some important medicinal plants *Rauwolfia serpentina* L. and *Bacopa monnieri* L. were chosen because of their ability to naturally synthesize and accumulate important secondary metabolites.

Objectives:

- Establishment of suitable protocol for *in vitro* plant regeneration and callus culture from various explants like leaf, node and root.
- Estimation of total alkaloid contents from field grown plants, *in vitro* grown plants and callus tissues.

Progress Achieved:

- High efficiency plant regeneration protocol has been developed from various part of *Rauwolfia serpentina* along with formation of callus.
- *In vitro* regeneration protocol has been established from root callus.



Fig: Multiple shoots were regenerated from leaf and nodal explants of *Rauwolfia serpentina*.



Fig: Shoot regeneration from root callus.

Large scale production of Agar plant (*Aquilaria agallocha* Roxb.) for commercial exploitation of Agar industry in Bangladesh.

Agarwood is a highly priced non-timber forest product, which can be used in fragrance, incense, medicines aromatherapy and religious ceremonies. Agar trees were previously collected from natural forests by agar traders for ages, but this has resulted in depletion of agar tree population in Bangladesh and the species is now a vulnerable one. The present research proposal proposes to develop a reproducible and fast protocol for large scale production of *Aquilaria agallocha*, the commercially important tree species through *in vivo* cultivation in different field.

Objectives:

1. Collection, plantation, growing and nurturing seedlings of *Aquilaria agallocha* in Rangamati and Chittagong BCSIR campus.
2. To compare survival rate of plantlets.
3. Seasonal performance observation.
4. Observation of growth rate in different zone.
5. To explore Agar plant in different area.

Progress Achieved:

- 7500 pcs agar seedlings are planred in Chittagong Laboratory garden. In the mean, 6213 seedlings growth is going good.

Chemical Research Division (CRD)



Chemical Research Division conducts R & D works in the different field of Natural and Synthetic chemistry. It consists of seven research sections: Chemical from Indigenous Sources section, Fine organic chemicals section, Gum and adhesive section, Industrial chemical section, Carbohydrate section, Essential oil soap and detergent section, Chemical industrial waste and Industrial inorganic chemical section. Along with the R & D works, scientists of this division are engaged to provide analytical services and also supervise the research work of M Sc, M Phil and Ph D student's thesis of different universities.

Research and Development (R&D) activities:

Natural antioxidant from indogenous sources and evaluation of their anti-inflammatory, anti-nociceptive, antidiabetic and other bioactive properties

Recent studies show that certain natural components may protect cells from oxidative stress as antioxidants, thus ameliorating various diseases such as diabetes,

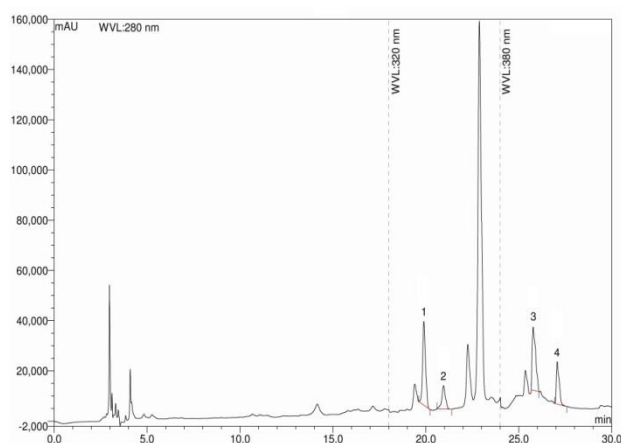
cardiovascular diseases, cancer, and various inflammation conditions. Thus, understanding of precise mechanisms of actions of natural products would shed light into the application of medicinal plants extracts/compounds on prevention and treatment of oxidative stress related diseases.

Objective:

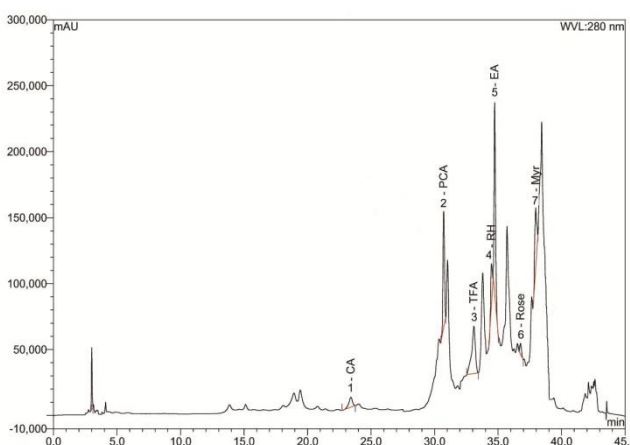
- *In vitro* studies: natural compounds from medicinal plants and herbs.
- *In vivo* studies: anti-inflammatory effects of natural components.

Work progress:

- Two International Publication have been published.
- HPLC profiling of polyphenolic compounds from the leaves of *V. peduncularies*&*Syzygium cumini* were studied.



HPLC chromatogram of *Trichosanthes Dioica*
(1: p-coumaric acid, 2: rutin hydrate, 3: quercetin, 4: kaempferol)



HPLC chromatogram of *Vitex peduncularies*(1: catechin hydrate; 2: p-coumaric acid; 3, trans-Ferulic acid; 4, rutin hydrate, 5, ellagic acid;6, rosmarinic acid; 7, myricetin)

Optimization of methods for preparation of low molecular weight chitosan and different type of chitosan derivatives for use as natural food preservatives

Synthetic fungicides/preservatives are the primary means to control postharvest diseases of fruits and vegetables. Concerns have been raised about the health risk involved in the use of synthetic fungicides/preservatives on fresh fruits and vegetables shortly before consumption. Chitosan derivatives can form a semi-permeable coating on food and thus reduces respiration and chance of infection.

Objective:

- Preparation of low molecular weight chitosan and chitosan derivatives from shrimp waste and use as natural preservative on fruits and vegetables.

Work progress:

- Experiment on Green Chilli and Mango of chitosan derivatives as natural preservative has been done and moderate satisfactory result has been shown. Preparation of low molecular weight chitosan through enzymatic method is going on.

Development of processes for production of aqueous and protein based foam concentrate for extinguishing Power plant and Aircraft fires.

Refineries and fuel storage tank farms (Truck/Rail loading, Vessels etc) and Civil aviation organization spend a lot of foreign currency to import protein based foam concentrates for extinguishing Class B fuel fires.

Objective:

- To develop process for the production of high efficiency, cost effective and import substitute aqueous and protein based foam concentrates.

Work progress:

- Quality control analyses of aqueous based foam concentrate have been completed.
- One process on protein based foam concentrate is ready for submission.
- One manuscript is ready for submission at international journal.

Production of useful Laboratory Chemicals as AlCl_3 from aluminum, $\text{Al}_2(\text{SO}_4)_3$ from $\text{Al}(\text{OH})_3$, Na_2S from Na_2SO_4 , FeS & FeCl_3 from iron for Research & Industrial use.

Research organizations, Pharmaceuticals, Industries and Educational Institutes in our country spend a lot of foreign currencies to get proper laboratory grade chemicals. It is our view to develop the process for the production of most essentially chemicals like, AlCl_3 , $\text{Al}_2(\text{SO}_4)_3$, Na_2S , FeS & FeCl_3 using local raw materials as well as industrial wastes.

Objective:

- The main object of this project is to develop the process for the production of said chemicals.
- This will reduce the dependency on foreign countries and save millions of foreign currency.

Work progress:

- A process for the production of anhydrous aluminum sulfate from scrap aluminum has been verified by the BCSIR authority.
- Another process for the production of sodium sulfide from sodium sulphate has been accepted by the BCSIR authority.

Development of method for cost effective and quality upgradation of phosphate based dry fire extinguishing agent.

Dry Chemical fire extinguishers extinguish the fire primarily by interrupting the chemical reaction of the fire triangle. The multipurpose dry powder works by creating a barrier between the oxygen element and the fuel element on Class A, B & C fires. In this project, we will produce an multipurpose fire extinguishing agent by formulating mono-ammonium phosphate, ammonium sulphate, calcium carbonate etc.

Objective:

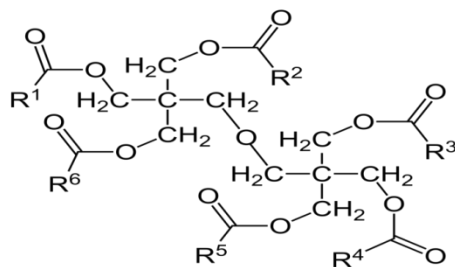
- To develop a process for the production of high efficiency and cost effective phosphate based fire extinguishing agent.
- Successful completion of this project will generate employment.

Work progress:

- Raw material have been collected and purified them well.
- Five different fire extinguishing agent were produced from the said chemicals in different proportion, analytical work of these product are going on.

Process for the production of esters and its derivatives from locally available chemicals and their bioactivity observations.

Esters are widespread in nature. Ester group can be synthesized in a number of different ways. The esters occur both in plants and in animals. In general esters have many uses in both living world and industries such as fragrances in foods, as explosive, for insect communication, in transparent plastics, in cosmetic formulations, nail polish remover, plasticizer, in glues as solvents.



Polyolester

Objectives:

- Our target is to synthesize different types of esters and its derivatives from locally available chemical using low cost easy available techniques.
- These will cut down the foreign currency, cost effective as at present all these esters are imported product.

Work Progress:

- One ester is prepared from locally available chemicals.
- Characterization of the prepared ester is going on.
- One process is now in progress.

Development of a technology for the preparation of derivatives from pectin extracted from mango peels

Mango is a tropical and popular fruit in Bangladesh. If we convert the wastes of mango into valuable product such as pectin and its derivatives, our country will be benefited. Pectin and modified pectin are used in food and pharmaceutical industries as gelling agent, stabilizing agent, excipients, binder etc.

Objectives:

- Modification of mango peel pectin to improve its dissolution into water for the reduction of time.
- Characterization of modified mango peel pectin and compare with the unmodified extracted pectin.

Work Progress:

Some derivatives such as Glycine –pectin already have been synthesized. Moreover, most of its characteristics have been observed, only a few left to do. It's expected that, within one or two month an article about glycine-pectin could be able to be submitted.

Development of technology for better utilization of fruit wastes (mango, pineapple and jack fruit).

The fruit waste from different industry of our country can be used as by product. The products such as oil, starch, flour etc can be produced using the waste of various fruits which would be used in textile & clothing industry etc. This work will reduce the import of these compounds. So that, it will be cost effective and it has a positive impact on the economy of Bangladesh.



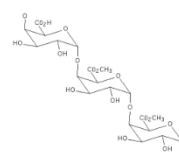
Mango



Mango peel



Mango peel pectin



Structure of pectin

Objective:

- To develop appropriate technologies utilizing residual parts of fruits.
- To isolate pure compound from the residual part of these fruits.

Work Progress:

- A process for the production of oil from kernel of ripe mango has been accepted. (Ref. 39.373.037.01.00.269.2015/222, Date: 19.01.2016).
- A process for the production of pectin from Jackfruit waste has been accepted. (Ref. 39.02.0000.043.37.002.17/1422, Date: 30.10.2017)
- Production of pectin from ripe Jackfruit waste has been accepted (Ref. 39.02.0000.043.37.002.17/1422, Date: 30.10.2017).

Synthesis of carbohydrate acetate composite (CAC) for use in waste water treatment

The content of heavy metals are increasing day by day due to pollution from various sources such as pigment, tannery wastes, leather manufacturing wastes etc in water and soil. Chitosan was prepared from prawn head shell via chitin (2-acetamino-2-deoxy- β -Dglucopyranose). Cellulose acetate was prepared by treatment of cellulose with acetic anhydride in presence of iodine at 80°C. Composite technology is the most modern technology in water treatment.

Objectives:

- Preparation of Chitosan from waste materials.
- Synthesis of chitosan composite from indigenous sources.
- Bio-composite will be a degradable media for waste water treatment.

Work Progress:

- CS and CA were characterized by FTIR, SEM and XRD.
- Removal of chromium (Cr) was investigated by atomic absorption spectroscopy (AAS).
- Cr (VI) removal efficiency of CE, CS and CA are found 16 %, 54 % and 61 % respectively.

Synthesis of novel biological active spiro and spiroketal compounds (phase-1)

Spiroketals are important natural products with biological activity. Spiro and spiroketals derived from natural products retain their biological activity, so that the spiroketal structure is suitable as a starting point for the development of API. Spironolactone use to treat heart failure, liver scarring, where the two 5-membered rings ring in the upper right hand corner compose a spiro ring system.

Objectives:

- To develop the process for the production of macro cyclic compounds.
- Study the synthetic routes of these compounds.
- Study of *in-vitro* antioxidant and antimicrobial properties of the spiro and spiroketals compounds.

Work Progress:

- One reaction between O-nitrobenzaldehyde and acetone was carried out to synthesis Michel acceptor (α,β -unsaturated carbonyl compounds) in presence of base (NaOH) as a catalyst.

Formulation and development of herbal Skin care products by introducing Neem, Turmeric and Aloe

Formulation and development of herbal Face Wash will be beneficial because. Natural remedies are more acceptable in the believe that they are safer than the synthetic one Herbal formulations have growing demand in the world Market. Most of these are imported at the cost of a foreign exchange.

Objective: The main objectives to develop an appropriate technology for the production of different types of skin care products from indigenous raw materials.

Work Progress:

Process: Production of Herbal Face Wash (Verified for acceptance).

Paper ready for submission: 01



Herbal Face Was

Formulation and development of ultrasound gel from ingredients available in local market

At present, no one in Bangladesh is producing this gel and thus Bangladesh has to import Ultrasound gel from China, India, Turkey and UK. That obviously makes it costly. Manufacturing Ultrasound gel from locally available ingredients will reduce the volume of import and will save valuable foreign currency.

Objective: The objective of present study involves to develop an appropriate technology for the preparation of Ultrasound gel from locally available ingredients.

Work Progress: Production of Ultrasound gel (Submitted).



Ultrasound Gel

FIBRE & POLYMER RESEARCH DIVISION (F&PRD)



Fibre & Polymer Research Division is one of the largest divisions of BCSIR Laboratories, Dhaka. It is a highly specialized research laboratory conducting R&D works on different branches of Polymer Chemistry and providing services to the large scale polymer-based industries of Bangladesh by developing knowledge-based analytical methods. The advanced and fully functional Fibre & Polymer Research Division has been developed under an ADP Project titled "Development of Fibre & Polymer Laboratory of BCSIR (July-2012 to June-2016)" and proposed for accreditation as per ISO-17025 standard. R&D activities of the division are mainly focused on Textiles, Jute, Wood, Rubber, Plastic, Bitumen, Paint, Dyes & Pigments, Plastic & Rubber Waste Management & Utilization System, Textile Effluent Treatment, etc. This division is gradually increasing its capability to reduce the dependency on foreign laboratories in the field of polymer analyses. The ultimate objective is to ensure sustainable development of the country applying Polymer Science & Technology.

Research and Development (R&D) activities:

Utilization of Plastic/Rubber Wastes in Road/Pavement Construction

Addition of waste plastics/rubbers into traditional penetration grade bitumen resulted higher values of softening point, lower values of penetration index, water resistance and improve viscoelastic properties. The aim of present work is to develop noble polymer modified bitumen of appropriate viscosity grade that is required to bear higher traffic load, resistance to water and tolerate large temperature variation due to climate change.

Objectives:

- Development of "Polymer Modified Bitumen" for Sustainable Pavement Construction.

- Development of "Appropriate Plastic & Rubber Waste Management & Utilization System in Bangladesh".

Work Progress:

- A "Noble Bitumen modification Process" has been developed.
- Utilization of Waste Polyethylene, Polypropylene, etc. has been ensured.
- Polymer Modified Bituminous Pavement has been constructed and showed better properties than traditional one.
- Guideline for "Appropriate Plastic & Rubber Waste Management & Utilization System for Sustainable Pavement Construction in Bangladesh" is ready for submission.

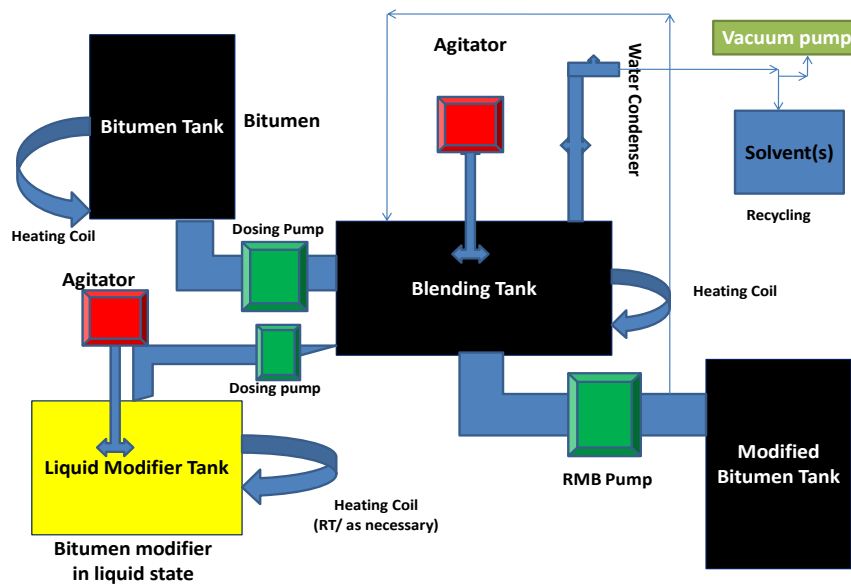


Diagram: Modification of Traditional Bitumen

Figure: Monitoring of constructed pavement

June-2017 (Construction of pavement using polymer modified bitumen)	August-2017 (Constructed polymer modified bituminous pavement)	September-2017 (Water clogged pavement due to heavy rainfall)	September-2018 (Pavement constructed at the same time using general bitumen)	October-2018 (Appearance of the polymer modified bituminous pavement)

Synthesis of lignin derivatives and their utilization in Paint, Adhesive, Cement, Agriculture, Food & Cosmetic Industries

Lignin is the second largest natural aromatic polymer obtained from different lignocellulosic biomasses. It has no significant use in Bangladesh except burning & heat generation or land filling. As a renewable resource, lignin's substitution potential can be extended to many industrial products currently sourced from petrochemicals.

Objectives:

- Preparation of technical lignin derivatives and their applications in large scale industries.
- Development of eco-friendly production technologies through green chemical approach.

Work Progress:

- Production process of Technical Lignin has been developed.
- Production process of Sulfomethylated Lignin has been developed.
- Production process of Nitrolignin has been developed.



Renewable Biomasses



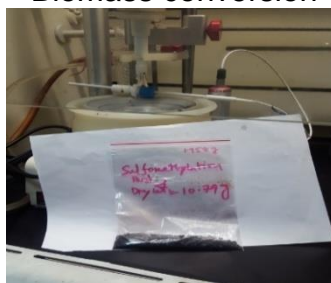
Biomass conversion



Isolation of Lignin



Prepared Technical Lignin



Sulfomethylated Lignin



Prepared Nitrolignin

Some activities performed

Development of “Functional Polymer-grafted Cellulose Powder” to be used in Textile ETPs

Textile effluent treatment is a very important issue to conserve surface water clean and pollution free. Several physical, chemical and biological treatment technologies have been used for treating textile effluents. Many of these are cost prohibitive, especially when applied for treating large waste streams. Application of absorption/adsorption

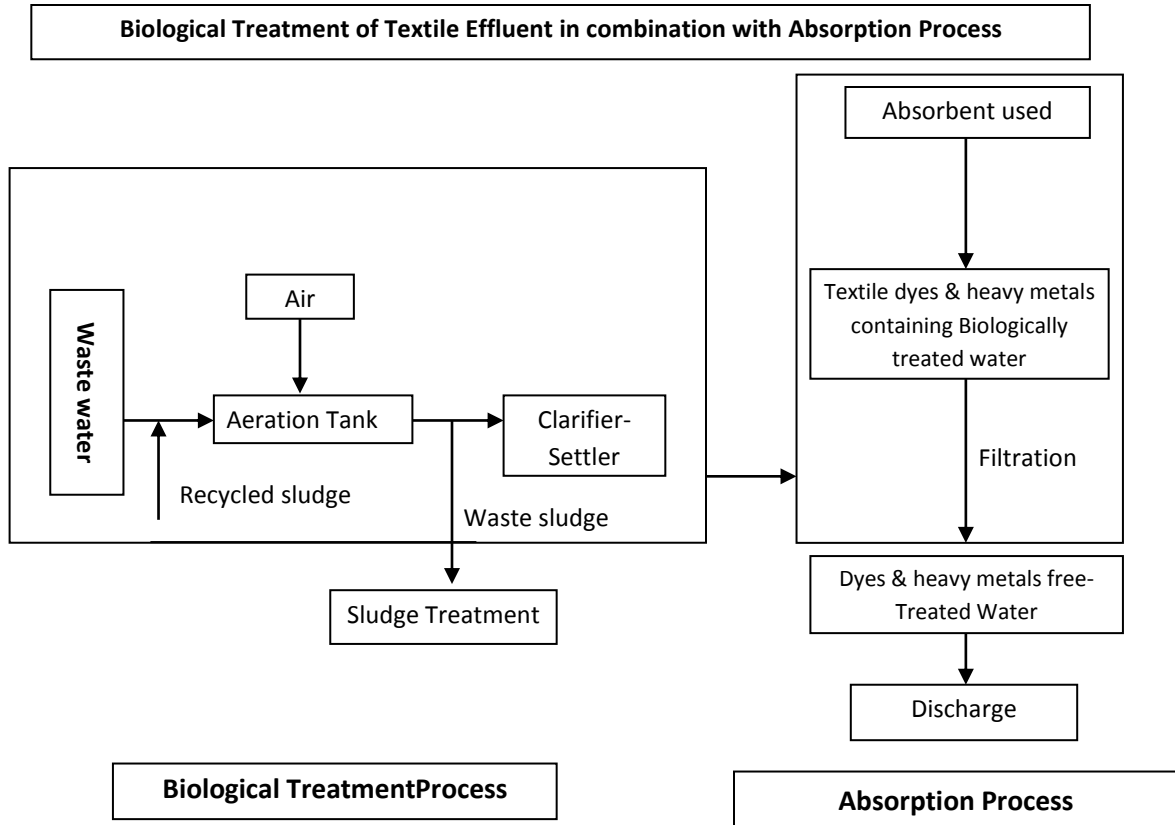
technology seems to have potential one for the treatment of non-biodegradable dyes & heavy metals containing textile effluent.

Objectives:

- Utilization of lignocellulosic biomasses to prepare effective polymeric absorbent.
- Development of effective “Textile Effluent Treatment Technology” to control surface water pollution.

Work Progress:

- Laboratory scale polymeric adsorbent has been prepared, characterized and applied for removal of dyes & heavy metal ions from textile waste water.
- Work on pilot scale production of polymeric adsorbent is in progress.



Textile ETP (Model: Lab Scale)

Investigation on maximization of diversified use of whole jute plant

There are no limits the importance of jute and its diversified properties as its traditional origin and agro-based country of Bangladesh. Beside the traditional use of jute some value added diversified products and there probable uses area are finer yarn

production, decorative fabrics, food grade packing bag, agro textile and, geo-textile, jute composite. In this project jute based cellulose derivatives and polymer composites like cellulose reinforced pp, pe and polystyrene composite using jute fibre will be prepared



Fig. Jute plant



Fig. Cellulose from jute fibre

Objectives:

- Development of jute based cellulose derivatives
- Preparation of jute fiber based polymer composites

Work Progress:

- Two research paper published.
- Preparation of Cellulose acetate and Methyl cellulose from jute based cellulose is going on.

Synthesis of textile grade dyes and pigments from natural waste materials for dyeing of fabric and formulations of ballpoint ink

Natural waste materials such as lingo-cellulosic waste, tea waste, fruit waste, vegetable waste etc. are the abundant renewable-natural resources in Bangladesh. Synthetic dyes and pigments are not eco-friendly and most of these are harmful for carcinogenicity. But the natural dyes and pigments are nontoxic, non-allergic and eco-friendly.

Objectives:

- Isolation of dyes and pigments from cellulosic waste sawdust, tea waste and fruit waste materials.
- Application of the dyes and pigments for dyeing textile fabrics by developing appropriate and standardized dyeing techniques.

Progress Achieved:

- Technical Procedure has been developed for natural dyeing of jute fibre and cotton fabric.
- Color fastness and tensile properties of the dyed materials are evaluated.
- Manuscript is ready for publication.

Preparation and characterization of nanocellulose reinforced polymer nanocomposites

Introduction: Nanocomposites, in the recent years, have earned huge interest in many industries mainly cellulose based forest industries, packaging industries including food grade and plastic industries etc. Nanocelluloses are nano-structured cellulose and their potential application fields are optical films or coating, barrier films, as rheology modifiers in many industrial applications of paints, coatings, adhesives, lacquers, food, cosmetics, drugs, and cements etc.

Objectives:

- To synthesize nanocellulose from indigenous cellulosic fibres including jute by chemical process.
- To prepare nanocellulose reinforced thermoplastic polymer nanocomposites using different types of thermoplastic matrices.

Work Progress:

- Nanocelluloses from jute fiber and sawdust have been prepared. Preparation of thermoplastic based nano-composite materials reinforcing with nanocellulose are completed.

Synthesis of thermoplastic modified thermosetting polymers, composites and nanocomposites

Thermosetting polymer networks tend to have a characteristic low resistance to brittle fracture. To increase toughness, some research works have been found in literature on the modification reaction of thermosetting polymer. In this research works, the prepared thermoplastic modified thermosetting polymers, composites and nanocomposites might be used in adhesive industry, packaging industry, and plastic industry, automobile and other industrial applications respectively.

Objectives:

- To synthesize thermoplastic modified thermosetting polymer.
- To prepare composites/ nanocomposites using these synthesized modified thermosetting polymers with treated and untreated natural fibers.

Work Progress:

- PVA modified urea formaldehyde resin has been synthesized and characterized.
- A poster has been presented in the 17th Asian Chemical Congress on 23 - 28 July 2017 at the Melbourne Convention Centre, Australia.

Development of Polyaluminum Chloride to be used as coagulant for textile waste water treatment

Wastewater treatment technologies are cost prohibitive. Application of effective coagulant seems to have the most potential for treatment of waste water because coagulation and filtration are the heart of conventional water treatment plants. Polyaluminum chloride (PAC) is a pre-polymerized coagulant which has been used extensively in recent years in such that it has become one of the most common coagulants in different water and waste water treatment plants.

Objectives:

- To develop an appropriate technology for the preparation of Polyaluminum Chloride (PAC) coagulant for waste water treatment.
- Utilization of available scrap /waste aluminum and other low cost chemicals.

Progress Achieved:

- Synthesis of Polyaluminum Chloride (PAC) : Some batches are prepared
- Characterization of laboratory prepared PAC is in progress

Industrial Physics Division (IPD)

Industrial Physics Division (IPD) has been engaged in the cutting-edge R&D activities in the field of materials and energy for sustainable development. Scientists and Researchers of this division play a pivotal role to solve problems quickly in a wide range of academic and industrial areas, devising custom-made tools and using unconventional techniques for better understanding the synthesized as well as imported products. Tailoring material properties at the nanoscale as well as adopting advanced and high-precision measurements techniques is the core of IPD activities to fulfill the needs of diverse stakeholders as well as for upholding the country's scientific development strategy.

Research and Development (R & D) activities:

Process for production of furnace inner (silica) brick from waste materials.

There are huge numbers of automatic/ semi-automatic rice mills in Bangladesh and produced large amount of rice husk which are not used as a value added product. We will produce furnace inner (silica) brick by using silicon-di-oxide as a raw material that we get from recycling/acid treatment of rice husk. Now-a-days we are dependent on foreign market for quality silica brick. But if we will produce silica brick from such local waste materials our industries as well as our environment will be benefited and save foreign currency.

Objective:

- To produce and characterize silicon-di-oxide from rice husk
- To produce and characterize furnace inner (Silica) brick from waste

Work Progress:

- Silicon-di-oxide from rice husk have produced and characterized
- We have prepared some samples and need to characterize those samples.
- We need to achieve optimum characteristics of the samples.

Process for production of tailor chalk (marker) from paper mill sludge.

There are hundred (Apx) paper mills in Bangladesh and produced near about 80 metric tons sludge per year. These wastes pollute our top soil as well as our environment. We will produce tailor chalk (marker) by using paper mill sludge to add value to the waste materials/sludge. Now-a-days we are dependent on foreign market for quality marker. But if we will produce tailor chalk from such local waste materials our industries as well as our environment will be benefited and save foreign currency.

Objective:

- To characterize paper mills sludge.
- To recycle paper mills sludge: Pulp and residue.
- To produce value added product (tailor chalk) from paper mills waste and characterize the produced product.

Work Progress:

- Collected sludge from different paper mills and characterized.
- Till now tailor chalk with various formation have been prepared.
- Some of the physical characteristics of the product have been examined and compared with that of imported one.

Synthesis and characterization of co doped dielectric material for ceramic capacitor

A ceramic capacitor is a fixed value capacitor in which ceramic material acts as dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. Use of high performance dielectric materials for ceramic capacitor is increasing day by day. On the basis of analysis and results of the prepared samples, developed materials will be employed for practical use for ceramic capacitor.

Objectives:

- To synthesize dielectric material as import substitute.
- To characterize the samples by XRD, SEM/EDS, Impedance analyzer
- To study the physical, electrical and dielectric properties of the samples

Work Progress:

- Three sets of doped and co-doped BaTiO₃ samples have been synthesized. Characterization of all sets has been done by XRD and SEM & EDS, Electrical and dielectric analysis by Impedance analyzer.
- One M.Sc. student is working under this project.
- A research paper is ready for publication.

Synthesis and Application of Magnetic nanoparticles (Fe₃O₄) for waste water treatment

All around the world, countries are fighting to keep their drinking water clean. In Bangladesh clean water conditions are very much severe. Water used in home, industries and business premises must be treated before it is released to the environment. In our present study magnetic nano-particles will be used for detection and removal of chemical and biological substance including metals in waste water so that we can get to easy access for clean water and protect our environment and health easily.

Objectives:

- Magnetic nano-particles (Fe₃O₄) with different particle sizes will be synthesized and characterized.
- To find out the possibilities of these particles in waste water treatment.
- To make the best use of these particles in waste water treatment.

Work Progress:

- Magnetic nanoparticles (Fe₃O₄) have been prepared by Sol-gel method.
- Prepared oxides were characterized by SEM, FTIR, XRD.

- Nanoparticles have been used to remove chromium from waste water.
- One research paper has been accepted for publication in international journal.

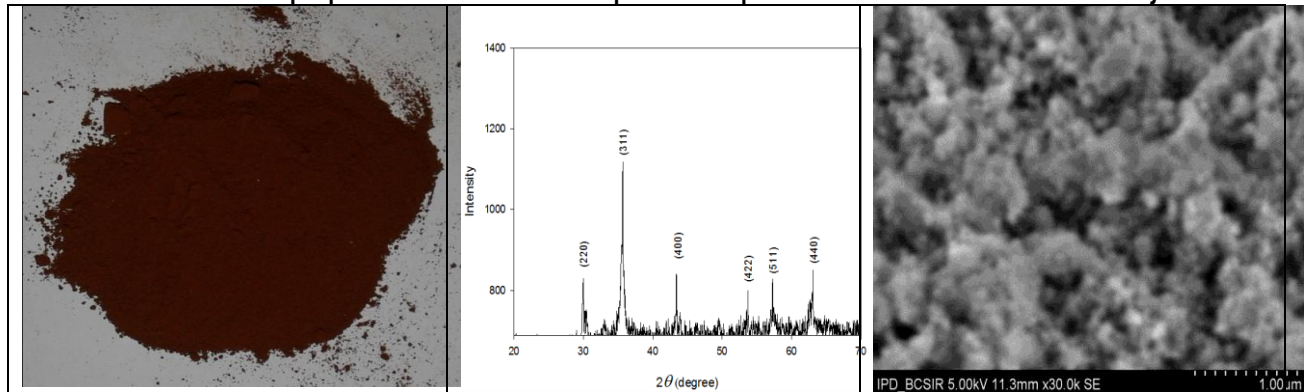


Figure: XRD of Magnetic nanoparticles. SEM of Magnetic nanoparticles.

Development of ferromagnetic particle through chemical route

Ferrite is a very important material for the application of modern engineering. The properties of various ferrites are used for electronic as well as electrical applications. These materials have very high resistivity which gives low losses in power devices. The properties of ferrite depend on preparation technique and substitutions.

Objectives:

- To produce ferromagnetic nano-particles.
- To analyze the various scope of this particles in magnet production.

Work Progress:

- Zn doped cobalt ferrite and Ni-Cu-Zn ferrite were synthesized by sol-gel method.
- Characterization of samples has been done by XRD, SEM, EDS, VSM, Electrical and dielectric analysis by Impedance analyzer.
- Two papers were submitted in journal and one paper will ready for submission.

Low cost and Environment friendly semiconducting materials synthesize and property optimization for solar cell applications.

Introduction: The current technology behind the production of solar cell modules is very expensive because of the scarcity of raw materials and sophisticated manufacturing technique. The cost factors during mass production (e.g., Silicon(Si)-wafer based photovoltaic(PV)) and toxicity as well as resource limitation of the base elements (e.g., CdTe and CuInGaSe₂ (CIGS) thin film PVs) of these PVs limit their practical potential in the case of Tera Watt(TW) level solar panel deployment. This R&D project focuses mainly on synthesis and property optimization of earth abundant materials for solar cell applications.

Objectives:

- To synthesize wide band gap ($E_g > 3$ eV) electron conducting thin films (n-Type).
- To synthesize low and Intermediate band gap ($E_g < 2.5$ eV) hole conducting (p-Type) as well as absorbing layers.

- To characterize deposited n- and p- type layers and their property optimization for integrating them into PV device.

Work Progress: *n-Type materials:* Zinc oxide(ZnO) and Al-doped ZnO(AZO) thin films have been grown on both amorphous glass and FTO substrates and deposited films were characterized by SEM, XRD , UV-VIS-NIR and RT-PL spectroscopy for property optimization(see figure 1 below) for realization of ‘All-Oxide Based Solar Cells’

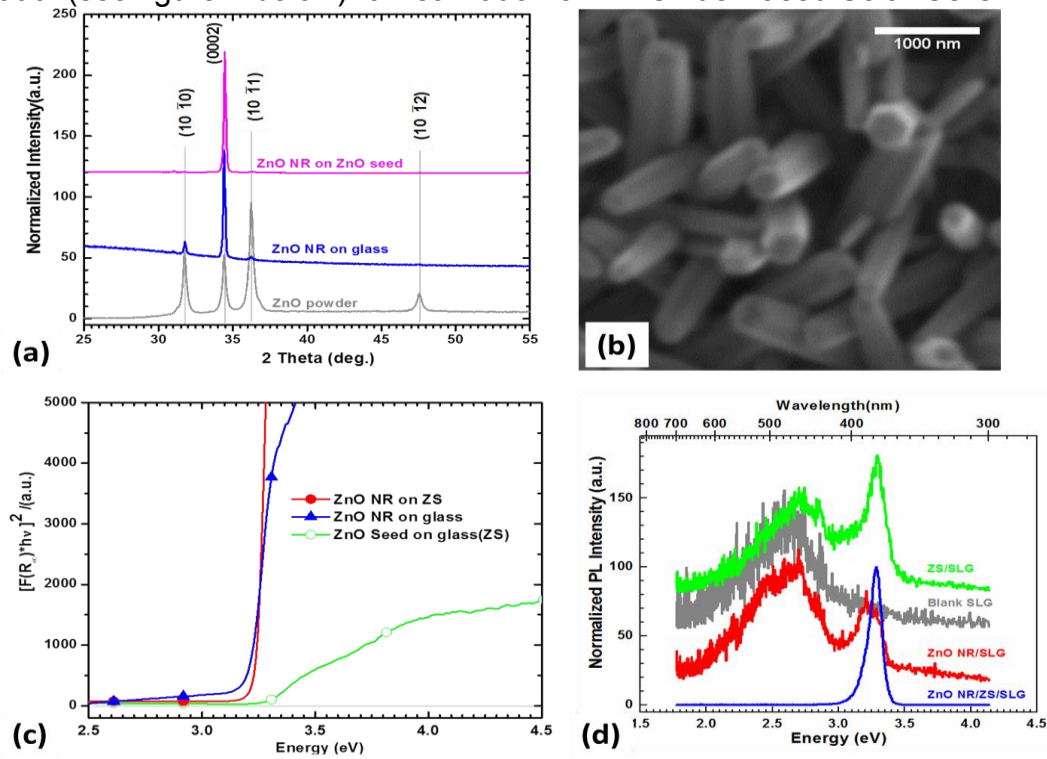


Figure 1 : (a) Crystalline structure(XRD), (b) Surface morphology(SEM), (c) Diffuse Reflectance(UV-VIS-NIR),(d) Room temperature Photoluminescence(RT-PL) of Nanostructured Zinc oxide thin films.

p-Type materials: Copper Oxides(Cu_2O , CuO) thin films have been grown on amorphous glass, quartz and conducting polycrystalline substrates by modified Successive Ionic Layer Adsorption and Reaction(m-SILAR)technique. Structural, Optical andPhotoelectrochemical properties of the deposited films investigated by variety of characterization techniques (Figure 2).

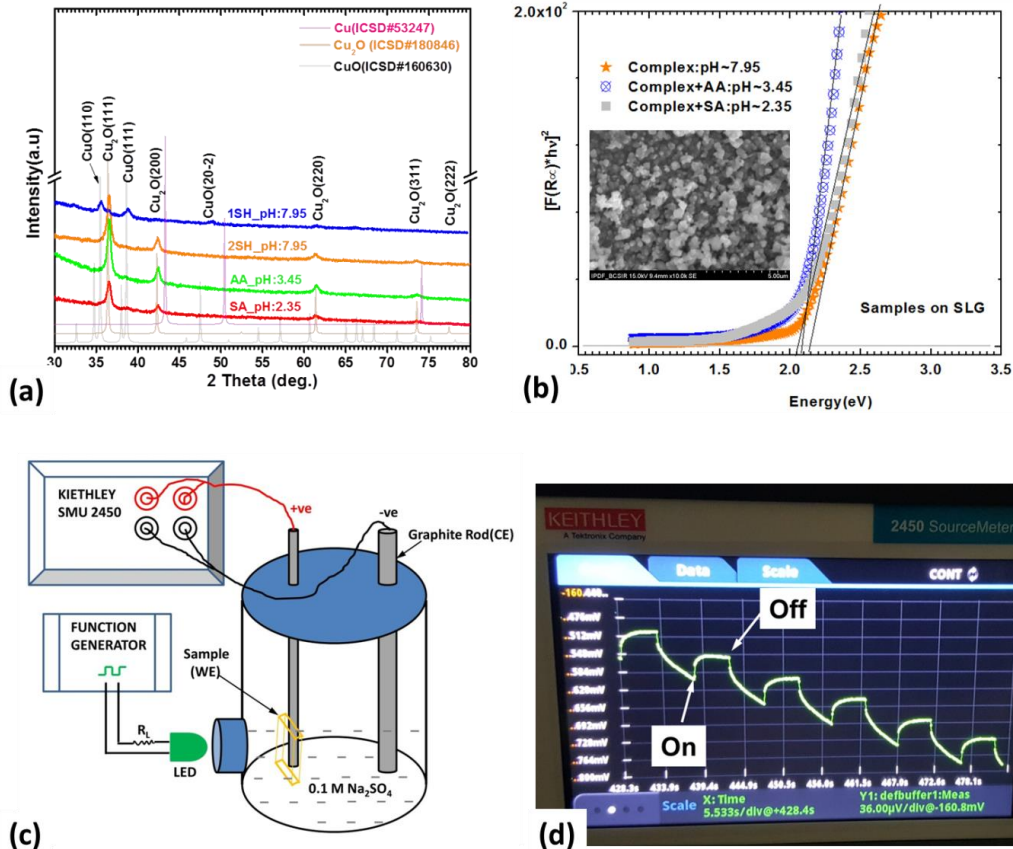


Figure 2: (a) Crystalline structure (b) Optical Bandgap(SEM image inset) and (c) Home-built measurement setup for Surface Photovoltage(SPV), and (d) Transient SPV of a typical copper oxide photocathode grown by SILAR method. In transient SPV measurement working electrode(WE) is Cu₂O/FTO and counter electrode(CE) is graphite rod.

- Two B.Sc.(Project) students, one M.Sc. thesis student accomplished their research works and one M.Phil student pursuing thesis works under this project.
- A research paper is under review for publication and two other papers are in preparation.

Construction of Low cost equipment for developing Standard Test Methods for measuring Electrical Conductivity of Liquid and Solid Materials

Electrical conductivity is one of the inherent properties of any substance based on which they are classified as metal, semiconductor, insulator as well as dielectric materials. The conductance measurement spans many different ranges which require the different probing techniques of the test sample as well as sensitive equipment to reduce error and measurement accuracy. Therefore, this project mainly deals with design, construction and development of low cost equipment as well as development of standard testing methods (STMs) for measuring conductivity of diverse materials using our homemade equipment.

Objectives:

- To develop STMs for measuring electrical conductivity of our research samples as well as samples received from the public and private stakeholders.
- To validate the testing methods using home built equipment that 'fit-for-purpose' of different stakeholders.
- To locally construct/fabricate custom made affordable test equipment for research institutes as well as for college/university science laboratories.

Work Progress:

- A couple of equipment and sensitive probing accessories have been built locally.
- STMs are developed for Ultra-high and ultra-low resistivity (conductivity) of diverse solid samples have been accomplished and for liquid samples works are going on.
- A patent (spin-coater) application has been submitted.

Primary design and construction of some prototype equipment and probing accessories are shown in Figure 3 below.



Figure 3: (a) Universal test Jig, (b) Adaptors for solid and liquid samples, (c) Sensitive Ultra-high and ultra-low resistivity measurement setup for thin and thick films, and (d) A preliminary designed proto-type portable (vacuum pump free) spin-coater for depositing conducting thin films.

Fabrication of highly Transparent and Conducting Substrate (TCS) using low cost and environment friendly materials for consumer electronics.

Transparent and Conducting Substrates (TCS) is one of the major components for consumer electronics such as flat panel displays, smart phone, touch screen, low-emissivity energy-conserving windows, photo-electrochemical device and more importantly in solar cells. This project focuses on the use of low cost and environment friendly materials for the facile fabrication process of highly transparent and conducting substrates/electrodes for optoelectronic and photonic industry.

Objectives:

- To develop processes for the facile fabrication of Binary/Ternary copper oxide, AZO, FTO, NiO and Graphene(reduced Graphene oxide).
- Optimization of physical and chemical properties of synthesized TCS and study of their performance compared to the commercial TCS.
- Production of the Graphene and reduced Graphene oxide conducting ink for the energy storage and corrosion protection coating.

Work Progress:

- Highly crystalline with controlled orientation and solar cell grade copper oxides have been grown by a facile 2-electrode Electrodeposition technique. The initial characterization results of the deposited products are shown in Figure 4 below.
- One B.Sc. (Project) students and one M.Sc. (thesis) student accomplished their research works under this project.
- Analyses of the characterization results of the deposited product are going on and expected at least two research publications in the peer reviewed journal.

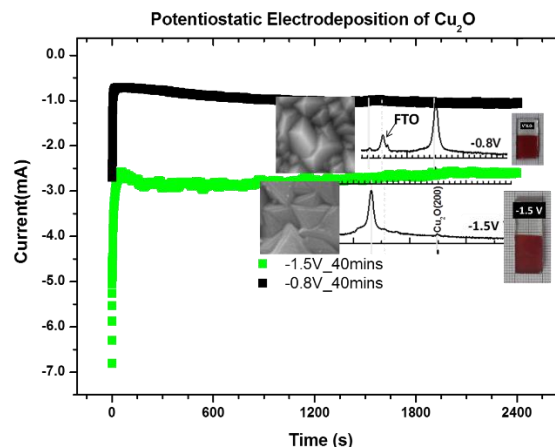


Figure 4: Highly textured and well-faceted Cu_2O oxide thin films grown by a home-built 2-electrode Electrodeposition setup. The graph is showing reasonably stable cathodic currents over the deposition period. Photographs, SEM images, XRD[$\text{Cu}_2\text{O}(111)$ textured thin film at -1.5V and $\text{Cu}_2\text{O}(200)$ textured thin film at -0.8V] of the products are shown in the inset.

Pharmaceutical Sciences Research Division (PSRD)

Pharmaceutical Sciences Research Division is continuously trying to improve R&D facilities in different sectors of pharmaceutical research including API and Pharmaceutical Excipients, Quality Assurance of Modern and Herbal Medicines, Drug Discovery and Bioassay, Dosage Form Design and Bioequivalence Study/Testing in order to help pharmaceutical sector of Bangladesh.

Research and Development (R&D) activities:

Synthesis of some commonly used antiulcerants.

Successful implementation of this project will help our Pharma Sector to reduce dependency on imported raw materials and thus, save foreign currency.

Objectives:

- i. Development of improved environmentally compatible synthetic routes of some antiulcerant APIs; such as Pantoprazole, Omeprazole, Esomeprazole etc. and their synthetic intermediaries.
- ii. Development and validation of analytical process for the synthesized drugs and their related impurities.
- iii. To transfer technology from R&D to actual manufacturing facilities.

Work Progress:

- i. Synthetic schemes was designed for 03 (three) APIs namely, Pantoprazole, Omeprazole and Esomeprazole.

Bioassay screening of extracts, fractions and isolated metabolites obtained from natural sources.

This project is an effort through a combination of basic and applied research to search biologically active anticancer/anti-inflammatory/other bioactive compounds and perform these preliminary activities related to drug discovery.

Objectives:

- i) Screening of anticancer/anti-inflammatory/other bioactivities of extracts, fractions and metabolites.
- ii) Support pharmaceutical sectors to develop newer drugs and medicines.
- iii) Help to build knowledge and develop manpower capable to work in bioassay laboratory.

Work Progress:

- i) Anticancer activity of several isolated compounds and extracts of plant endophytic fungi have been screened on African green monkey kidney (Vero) cell line (Table 1 & Table 2).
- ii) Antimicrobial activities of different plant and endophytic fungal crude extracts, their column fractions and pure compounds were screened.

Table 1: 05 (five) compounds named as Code **(1)-(5)**, from the plant *Thysanolaena maxima* (Roxb.) were screened for their activity and following result was obtained:

Compounds	IC ₅₀ (µg/mL)
Code (1)	7.6
Code (2)	10.0,
Code (3)	38.85
Code (4)	5.82
Code (5)	28.96

Isolation of bioactive metabolites from marine weeds and sponges as well as their associated symbiotic fungi.

Marine weeds are relatively unexplored but rich resources for bioactive compounds. For their survival in harsh environmental conditions they are producer of structurally unique secondary metabolites with diverse bioactivity.

Objective:

- i) To explore the marine weeds and sponges as well as their associated symbiotic fungal extracts and screen them for bioassays.
- ii) To purify crude extracts for isolation of active compounds.
- iii) To complete the total structure elucidation of the active compounds using NMR and MS.

Work Progress:

- i) 10 marine species were collected and 15 associated fungal endophytes were isolated.
- ii) Small scale cultivation has been completed for 7 fungi in different media.
- iii) Large scale cultivation of one fungal strain has been completed.
- iv) One MS thesis has been completed under this R & D project.

Taxonomical identification of symbiotic fungi from medicinal plants.

Endophytic fungi which are the rich sources of novel and lead bioactive compounds must be properly identified to reproduce those bioactive compounds for drug development work and to explore the taxonomic diversity and species richness of fungi from plant origins.

Objectives:

- i) Exploration of endophytes/symbionts from different medicinal plants.
- ii) Proper identification of endophytes/symbionts by morphological characteristics and DNA sequencing.
- iii) Exploration of potential endophytic fungi for new drug development research.
- iii) To prepare a Gene Bank of symbionts/endophytes from medicinal plants.

Work Progress:

- i) More than 188 endophytic fungi were isolated from 23 medicinal plants. Of them, 170 fungi were morphologically identified upto genus level and 27 fungi were molecularly identified by DNA sequencing.

- ii) More than 120 fungi have been conserved by continuous culture and refrigeration under 4°C.

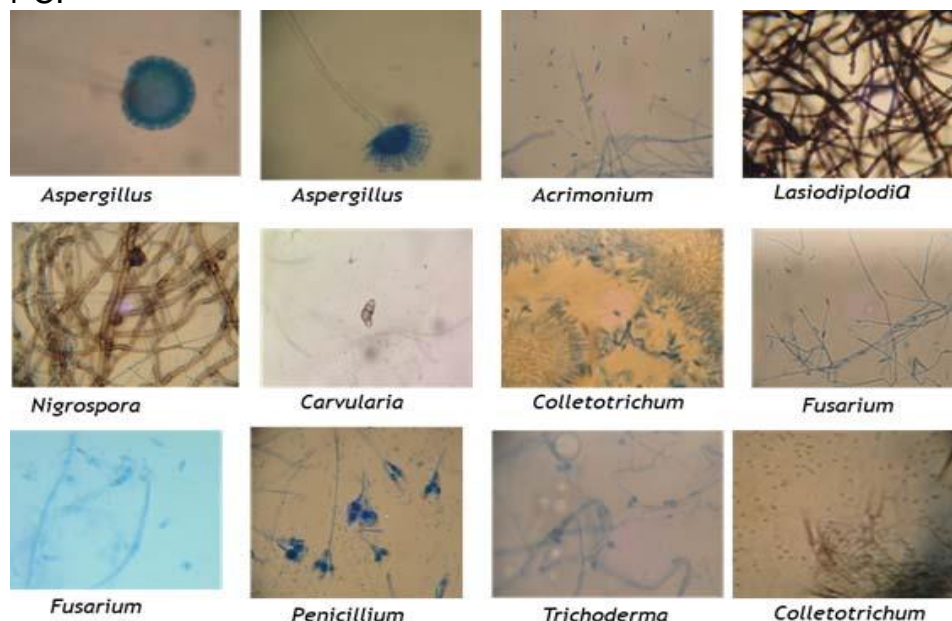


Figure 5: Microscopic Observation and Identification of Endophytic Fungi.

Analytical method development for determination of drugs in blood samples.

Successful implementation of the project will help to develop simple, reliable method to determine drugs such as Cephalosporins, Quinolones, Macrolides, NSAIDS and Proton Pump Inhibitors in blood sample which will be helpful for bioavailability and bioequivalence study.

Objective:

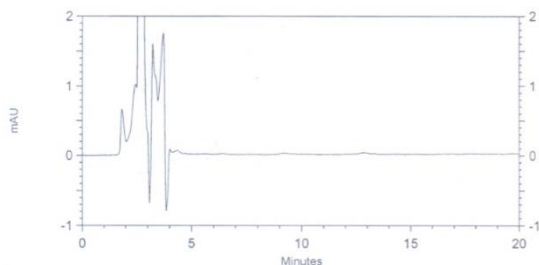
- i) To study bioavailability of drugs in blood samples.
- ii) Quantitative analysis of drugs in blood samples.
- iii) Optimization and validation of analytical methods developed for quantitative analysis of drugs in blood samples.

Work Progress:

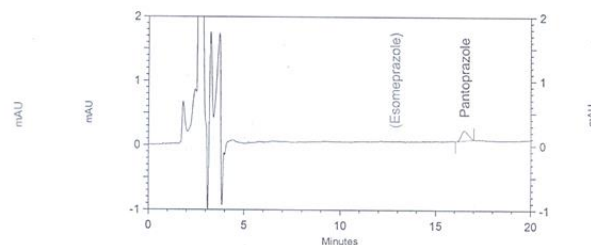
- i) 01 method has been developed for assay of Esomeprazole in blood sample,
- ii) 01 method validation is ongoing,

- iii) 01 SOP (standard operating procedure) for bioanalytical method validation has been prepared.

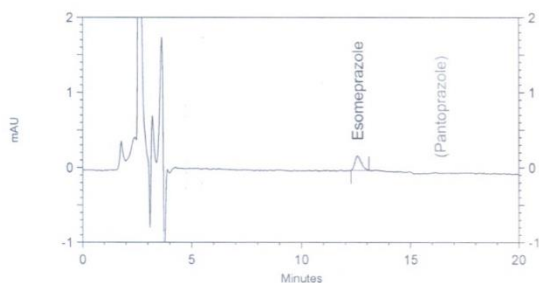
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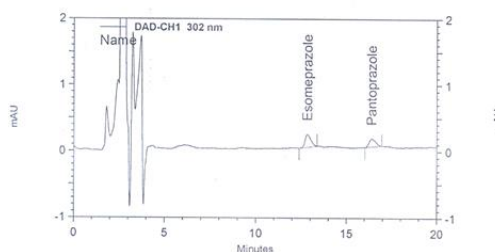
Pantoprazole:



Esomeprazole:



Esomeprazole and Pantoprazole



Chemical exploration and value addition in bioactive molecules isolated from medicinal plants and their associated endophytic fungi.

Endophytic fungi residing within healthy plant tissues hold a mutualistic relationship with host plant such as improving plant growth by overcoming contaminant-induced stress responses in turn receiving nutrition for their growth. This endophytic interaction with the host lead to production of diverse chemical entities by the endophytic fungi which can be utilized as lead compound in drug discovery process.

Objective:

- i) To discover novel bioactive molecules from medicinal plants and their associated endophytic fungi using modern separation, isolation and spectroscopic techniques.
- ii) Value addition of discovered bioactive molecules through the development of precise, rapid and sensitive analytical method of detection and quantification.

Work Progress:

- i) A total number of 39 plants were investigated and a number of 221 endophytic fungi were isolated from those plants.
- ii) 51 secondary metabolites (both new and known) have been isolated from different endophytic fungal strains.
- iii) From beginning in 2015 till June, 2018, 02 PhD and 45 MS dissertations have been submitted and 05 Research fellow in postdoctoral, doctoral and post graduate level have been completed their research work under this project.

Physical Instrumentation Division (PID)

The main works of PID are:

- ❖ Maintenance, repairing, servicing and installation of scientific equipment and electronic instrument.
- ❖ Conduct research for development of Laboratory equipment locally.
- ❖ Provide computer training (software and hardware).

Research and Development (R&D) activities:

Design and development of Microcontroller based Automatic Voltage Stabilizer.

AC power supplied by PDB (Power Development Board) in Bangladesh is subjected to variation from time to time and hence creating surge at the output which can damage valuable electronics. This research handled both shortcomings and introduced in the tolerable range of 160-280 volt using several taps to keep the voltage constant to the particular equipment.

Objectives:

- To develop Automatic Voltage Stabilizer using locally available raw materials.
- To study and develop the control techniques of conventional Voltage Stabilizer.

Work Progress:

- Circuit design and Algorithm design are completed.
- Circuit Simulation is going on.

Development of Smart Control and Monitoring System for Electrical and Electronic equipment using Internet of Things (IoT).

Controlling and monitoring electrical appliances using computer and smart phone with the help of internet connection is possible. By using Internet of Things (IoT) in this research we can control and monitor many devices of research labs like HVAC (Heating, Ventilation and Air conditioning) systems, Water level of Water Distillation Plant, Generator (On/Off), Lab Refrigerator (On/Off), Light (On/Off), Fan (On/Off), and Lab Door (On/Off).

Objectives:

- To develop equipment's control and monitoring system to provide flexible and scalable architecture for automation.
- To develop android and web app to control and monitor equipment from everywhere.

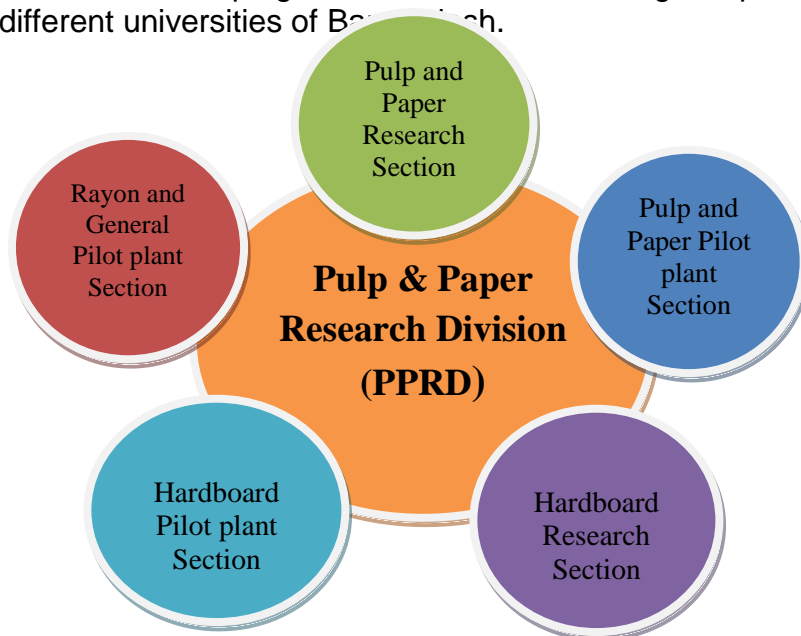
Work Progress:

- Circuit design and Algorithm design are completed.
- Android app development is going on.

Other Activities: Repairing, Servicing, Maintenance, Calibration and Installation of scientific/laboratory equipment: Services were provided to 28 Laboratory/Scientific Equipment (such as: Computer CPU, Printer, UPS, Autoclave machine, Hydraulic Press, Water bath, Microscope, Electric Oven, Centrifuge, Power Supply, LAN Card (NIC), Deep Fridge etc.)

Pulp & Paper Research Division (PPRD)

Pulp and Paper Research Division (PPRD) is one of the oldest divisions in BCSIR Laboratories Dhaka which plays a crucial role in the development of pulping technology for the pulp and paper industries in Bangladesh from its beginning. Many efforts have been given over the past decades to find out high yield biomass for pulp production as well as easy propagation for forestry. This research division is mandated to utilize locally available bioresources in producing pulp, paper and chemicals. Scientists of PPRD are going to develop a green pulping process for nonwood agricultural residues. Moreover, PPRD is developing human resources through supervising PhD and MS students of different universities of Bangladesh.



Research and Development (R&D) Activities:

Biorefinery initiative in producing rayon grade pulp from jute cutting & caddis

Recently Bangladesh Government is interested to produce rayon from jute fiber. Rayon is being produced from wood and jute fiber cannot complete it because of price. The price of jute fiber is around 50000 Tk/ton, whereas of the same of jute cutting and caddis is about Tk 40000 and Tk 5000, respectively. So using mixture of jute cutting and caddis can be a good option.

Objective:

- Prehydrolysis optimization of jute cutting, jute caddis and cutting-caddis mixture by varying time and temperature.
- Prehydrolysed kraft pulps were bleached through $D_0E_pD_1$ sequences.

Work progress:Prehydrolysis at 170°C dissolved biomass 22-32%, while at 140°C dissolved 2-10%. Dissolved biomass increased with the increase of caddis proportion in

cutting-caddis mixtures. The overall pulp yield was only 40.9% for 100% cutting prehydrolysed at 170°C, which was 10.9% lower than the prehydrolysis at 140°C. Pulp yield also decreased with increasing caddis proportion. Prehydrolysis at 170°C showed improved delignification than at 140°C. The final brightness (brightness 77-83% vs 82-88%) and purity of pulps (α -cellulose 94-97% vs 89-92%) obtained from the prehydrolysis at 170°C was better than that at 140°C. Cutting-caddis mixtures at the ratio of 50:50 prehydrolysis at 140°C produced pulp with higher yield and acceptable properties for rayon production.

Production of wood adhesive from spent liquor lignin

Acetic acid/formic acid/ water (AA/FA/H₂O) fractionated rice straw into lignin, hemicellulosic sugars, silica and dissolving pulp. Phenol is produced from fossil fuel. Lignin has a large number of phenolic group. Therefore lignin can be used in substituting phenol in phenol-formaldehyde resin preparation. Though Bangladesh has no resin industry it can utilize lignin to begin a new era of industrialization.

Objective:

- Separation, characterized of Lignin from rice straw
- Utilization of AA/FA/H₂O lignin in lignin-phenol-formaldehyde(LPE) resins preparation and Characterization of LPF resins

Work progress: Methoxyl group/C₉ unit of rice straw lignin was 0.87, while that was 0.75 in AA/FA/H₂O spent liquor lignin. The formaldehyde/phenol mole ratio (F/P) was 2.0, the NaOH/phenol mole ratio (S/P) between 0.3 and 0.5, and the percentage of substitution of phenol by lignin between 40 and 60%. The bonding strength of plywood was tested, and showed that LPF resin were comparable to phenol-formaldehyde resin. The results indicated this lignin was a feasible replacement of phenol in phenol-formaldehyde resins up to 50%.

Rapid Determination Method of Dissolving Pulp properties by Spectroscopic Data and Chemometrics.

Chemometric methods through multivariate analysis of spectroscopic data could be a cheaper and environment friendly alternative of existing methods for determination of dissolving pulp properties. Properties are quantified first with wet chemical methods. Next, spectroscopic data of the samples were collected after running them through UV spectrophotometer and Fourier Transformed-Near Infrared (FT-NIR) spectrophotometer. Spectroscopic data from both the instruments were pretreated and used for model development.

Objectives: The objective of the study was to develop a suitable method for determining dissolving pulp properties such as Pentosan, α -cellulose, R₁₀, R₁₈, Viscosity and Brightness.

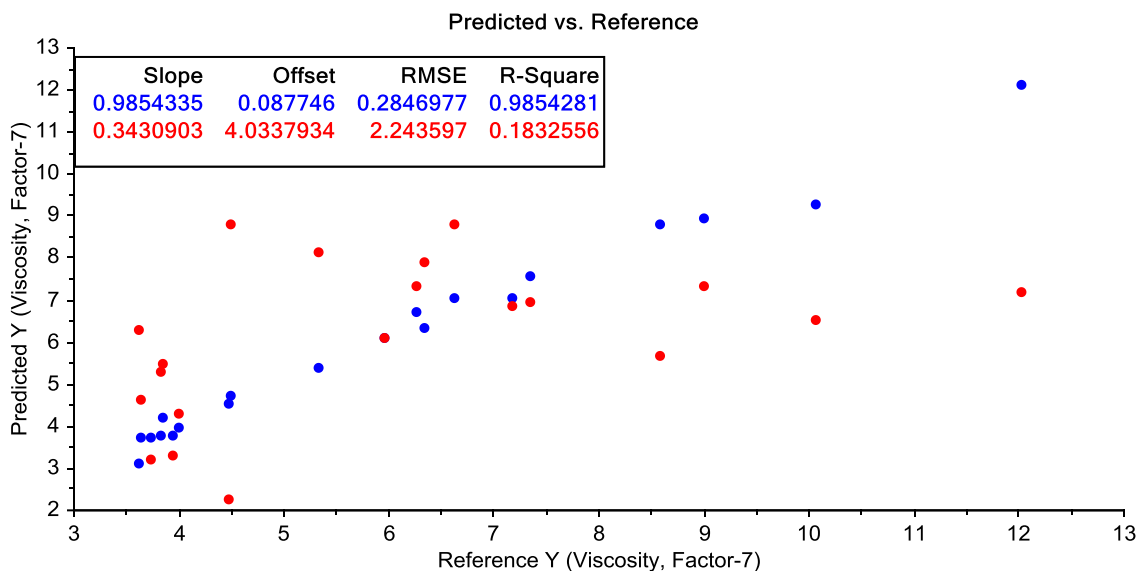


Figure: PLSR model for predicting Viscosity with UV-data

Work progress: PLSR produce better predictive efficiency than PCR both with UV and FT-NIR data of their raw and pretreated form. For quantification of pentosan, UV data pretreated with S-G (1st+2nd derivative) produce better results than FT-NIR data ($R^2 \approx 99\%$). Either of the instruments could be used for determination of α -cellulose and R_{10} ($R^2 \approx 99\%$). For viscosity measurement, pretreated FT-NIR data produce better result ($R^2 \approx 99\%$). Brightness could be determined with PLSR with FT-NIR raw data ($R^2 \approx 90.7\%$). The proposed chemometric method with pretreated spectroscopic data is a simple, rapid and cost effective technique to determine properties of dissolving pulp.

Achievements:

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Dr Most. Hosney Ara Begum, Nurzaman Ara Ahmed, Suravi Islam, Nazia Khatun, “ Produce Transformer core using soft ferrite material” accepted by the office, Member Development, BCSIR, Dhaka.

Dr. Most. Hosney Ara Begum, Md. Altaf Hossain, Tozammel Hoque, M.A. Gafur, “ The Process for Production of Aluminum base lubricating grease” accepted by the office, Member Development, BCSIR, Dhaka.

Participation in Foreign Training:

Dr Md Kamal Hossain Presents as Country delegator Thirteen session of the conference of the parties(COP-13), the Sixteenth session of the committee for the review of the implementation of the convention(CRIC-16) and the thirteen session of the committee science and technology(CST-13) and its high level segments, United Nations(UN), Ordos ,Inner Mongolia, China

John Liton Munshi participated in Summit “Tech4Farmers Asia Challenge 2.0”. 13-14 September 2017, being held in Bangkok, Thailand. Organized by USAID Feed The Future Asia Innovative Farmers Project

Swapan Kumer Ray, SSO; Md. Mahbubur Rahman, SSO; Mohammad Amirul Hoque, SSO and Muhammad Saiful Islam, SO participated in advanced application and maintenance training on UPLC-MS-MS System on 23-27 October, 2017 in Germany.

Dr. Syed Farid Uddin Farhad, SSO; attended Sixth International School for Materials for Energy and Sustainability 16-22 July, 2017 at California Institute of Technology, LA, USA .

Dr. S.F.U. Farhad attended 2nd RIS-ITEC capacity building training program on Science Diplomacy, 8- 19 January, 2018, New Dheli, India.

Mohammad Sajjad Hossain participated a training program on “Nano technology” form 18-06-2018 to 08-07-2018 in India

Dr. Mohammad Nashir Uddin participated a training program on “Pulp and Paper Making Technologies of Non-wood Fiber Materials”. Organized by: China National Pulp and Paper Research Institute (CNPPRI), Beijing, China, August 21- September 10, 2017

Jannatun Nayeem participated a training program on “Pulp and Paper Making Technologies of Non-wood Fiber Materials”. Organized by: China National Pulp and Paper Research Institute (CNPPRI), Beijing, China, August 21- September 10, 2017

Jannatun Nayeem participated a training program on “Nano-Technology Training Course” Organized by: Indian Institute of Engineering Science and Technology, Shibpur, India, 18 June-8 July 2018.

Award:

Dr. S.F.U. Farhad has been awarded full scholarship to attend the sixth International School for Materials for Energy and Sustainability (ISMES, VI), 16 – 22 July, 2017, California Institute of Technology (Caltech), Los Angeles, USA.

Dr. S.F.U. Farhad has been nominated by Ministry Science & Technology, Govt. of Bangladesh and awarded full scholarship of Ministry of External Affairs, Govt. of India to attend the 2nd RIS-ITEC capacity building program on Science Diplomacy, 8- 19 January, 2018, New Delhi, India.

Scientists pursuing M.S/M.Phil/ PhD Courses in home or abroad

S. M. Mahmudul Hasan, SSO, Chemical Research Division, BCSIR Laboratories, Dhaka pursuing Ph.D degree in Jahangir Nagar University, Department of Chemistry, under supervision of Professor Koushik Saha with the title Phytochemical and Bioactivity Studies on the Leaves, Stem Barks and Roots of *Crataeva nurvala* Buch.-Hum.

Shahin Sultana, SSO, Fibre & Polymer Research Division pursuing Ph.D degree in the department of Theoretical and Computational Chemistry, University of Dhaka, Bangladesh under supervision of (Dr. Mohammed Abdul Aziz, Professor and Dr. Md. Saiful Islam, Professor) and working on “Synthesis and characterization of modified acrylic polymers and natural fiber reinforced polymer composites” in 2016-2017 session.

Md. Mahbubur Rahman, SSO Fibre & Polymer Research Division pursuing Ph.D degree in the department of Chemistry, University of Dhaka, Bangladesh under the supervision of Professor Dr. Md. Abu Bin Hasan Susan, titled on “Ionic Liquids and Their Double Salts for Dissolution and Modification of Cellulose” in 2016-2017 session.

Shamima Akther Eti, SSO, Fibre & Polymer Research Division pursuing Ph.D degree in the department of Soil, Water & Environment, University of Dhaka, Bangladesh under the supervision of Professor Dr. Shahid Akhtar Hossain titled on “Development of Polyaluminum Chloride-Based Coagulants from Aluminum Scrap for the Treatment of Textile Wastewater” in 2017-2018 session.

Farhana Afroz, SSO, PhD Awarded, Flinders University, Adelaide, Australia.

A.D.A. Shahinuzzaman, SO, PhD pursuing, University of Texas at Arlington, USA

Mohammad Mustafizur Rahman, SSO, PhD course, University of Pardubice, Czech Republic.

Academic Research Guidance/Supervision:

Sl. No	Title of Research	Research Category (PhD/M.Phil/M.S)	Name of the Student	Name of academic Institution	Name of supervisors in BCSIR
1.	Status of Heavy Metals in Water and Sediment of part of the Meghna River, Bangladesh	MS Student	Mahmud Hassan	Jahangirnagar University	Badhan Saha
2.	Environmental Impact Assessment of Tongi Industrial Area on Surrounding Environment	MS Student	Mosa. Sohera Sultana	Jagannath University	Badhan Saha
3.	Environmental Impact assessment of Kanchpur BSCIC industrial area of Narayanganj on the surrounding environment	MS Student	Shahnaj Rahman Sumi	Jagannath University	Badhan Saha
4.	Assessment of heavy metal impact on soil and vegetable of Hatirjheel lake area and study of the physicochemical parameters of lake water.	MS Student	Md. Joynul Abedin	Jagannath University	Badhan Saha
5.	Risk Assessment and Toxic Effects of Metal Pollution in some Cultured Fish Species around Dhaka city	MS	Tamanna Jahan	Mawlana Bhashani Science and Technology University	Mohammad Moniruzzaman, SSO
6.	Heavy metal analysis of culture fish (Pangas)	MS	Pritika Rani Das(BK H1402MS 109F)	Noakhali Science and Technology University	Dr Md Kamal Hossain,SSO
7	Heavy metal analysis of culture fish (Telapiya)	MS	Saborni Swarna Das(BK H1402MS 104F)	Noakhali Science and Technology University	Dr Md Kamal Hossain,SSO
8.	Proximate and nutritional values of leaves, stems, flowers and seeds of <i>Scoparia dulcis</i> L.	M.S thesis	Momtahina Ria	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
9.	Proximate and nutritional values of leaves, stems, flowers and seeds of <i>Mikania cordata</i> .	M.S thesis	Md. Zahangir Alam	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
10.	Proximate and nutritional values of leaves, stems, flowers and seeds of <i>Tragia involucrata</i> L.	M.S Thesis	Md. Morshed Alam	Islamic University, Kushtia	Dr. Shahin Aziz, SSO

11.	Chemical and Biological Investigation on different Plant parts of <i>Andrographis Paniculata</i> (Burm. F.) Wall. Ex Nees.	M.Phill Research	Sharika Farhana	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
12.	Chemical and Biological Investigation on different Plant parts of <i>Eclipta Alba</i> (Linn.) Hassk.	M.Phill Research	Shirin Aktar Banu	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
13.	Chemical and Biological Investigation on different Plant parts of <i>Adiantum Flabellulatum</i> Linn .	M.Phill Research	Taslina Akhter	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
14.	Chemical and biological investigation of some medicinal plants.	Ph.D research	Kamrun Nahar	Islamic University, Kushtia	Dr. Shahin Aziz, SSO
15.	Synthesis of conducting and biodegradable organic polymers and composite materials for industrial application	Ph. D Thesis	Tanvir Sultana	Department of Chemistry, BUET	Dr. Husna Parvin Nur, Director and Dr. Md. Wahab Khan, Professor
16.	Agro-fiber reinforced polymer matrix based composite: Its prospects in Bangladesh	Ph. D Thesis	Mr. Pinku Poddar	Department of Applied Chemistry and Chemical Engineering, University of Dhaka	Dr. Husna Parvin Nur, Director and Dr. A. M. Sarwaruddin Chowdhury, Professor
17.	Syntheses of lignin derivatives and their utilization in paint and adhesive.	MS Thesis	Md. Saddam Hossain	Department of Chemistry, University of Dhaka	Swapan Kumer Ray, SSO
18.	Syntheses of lignin derivatives and their utilization in cosmetic industries	MS Thesis	Sayed Rashed ul Islam	Department of Chemistry, University of Dhaka	Swapan Kumer Ray, SSO
19.	Synthesis and characterization of Al doped BaTiO ₃	M.Sc. (Thesis)	K. M. Abu Hasnat	Department of Physics, Jahangirnagar University, Savar.	Suravi Islam – PSO
20.	Fabrication of Zinc Oxide (ZnO) Nanorods on Aluminium doped ZnO (AZO) seeding layers by hydrothermal method	M.Phil	Mukul Hossain	Department of Physics, University of Dhaka	Dr. S.F.U. Farhad -SSO
21.	Synthesis and Characterization of Electrodeposited Copper oxide thin films.	M.Sc.(Thesis)	Md. Mainul Hasan	Department of Physics, Jahangirnagar University	Dr. S.F.U. Farhad - SSO

22	Biological and chemical studies on bioactive compounds isolated from endophytic fungi of <i>Alstonia scholaris</i> .	MSc thesis completed	Mahbub a Yeasmin	Department of Biotechnology Genetic Engineering, Jahangirnagar University.	Dr. Farhana Afroz, SSO ₇
23	Isolation, identification and chemical profiling of endophytic fungi from <i>Swietenia mahagoni</i> .	MSc thesis completed	Mohammad Atikur Rahman	Department of Biotechnology Genetic Engineering, Jahangirnagar University.	Dr. Farhana Afroz, SSO.
24	Analytical Method Development and Validation of Sitagliptin in Bulk drug and Tablet Dosage Form	MSc thesis completed	Rifat Al-Naser	Department of Biotechnology and Genetic Engineering, Jessore University of Science and Technology	Suriya Sharmin, SO ₇
25	Isolation and Identification of Fungal Endophytes from Important Medicinal Plants.	MSc thesis.	Chanda Kana Roy	Department of Biotechnology and Genetic Engineering, Jessore University of Science and Technology	Dr. Farhana Afroz, SSO ₇
26	Isolation of bioactive metabolites from the marine weed <i>Hypnea muciformis</i> and its associated symbiotic fungi.	MSc thesis completed.	Mahmud a Akter	Department of Biotechnology and Genetic Engineering Discipline, Khulna University.	Dr. Md. Hossain Sohrab, PSO
27	Isolation of bioactive compounds from three ethnopharmacologically important plants of Bangladesh and their associated endophytic fungi.	PhD Research	Nazia Hoque	Department of Pharmacy, Jahangirnagar University.	Dr. Md. Hossain Sohrab, PSO.
28	Isolation of bioactive compounds from the medicinal plants <i>Cassia alata</i> Linn. and <i>Cassia obtusifolia</i> Linn.	PhD Research completed.	Nasima Khan	Department of Chemistry, Jahangirnagar University.	Dr. Md. Hossain Sohrab, PSO
29	Isolation of bioactive metabolites from endophytic fungi.	PhD Research	Muhammad Kamruzaman Sachu	Department of Pharmaceutical Chemistry, Faculty of Pharmacy,	Dr. Md. Hossain Sohrab, PSO

				University of Dhaka.	
30	Bleaching of Various Acacia pulps	MSc (thesis)	Maumita Nanjiba	Applied Chemistry & Chemical Engineering, University of Dhaka	DR. M Sarwar Jahan
31	Pulping of Acacia Mangium	MSc (thesis)	Mr. Sharif Hossain	Applied Chemistry & Chemical Engineering, University of Dhaka	DR. M Sarwar Jahan
32	Pulping of Acacia Hybrids	MSc (thesis)	Md. Iqbal Aziz	Applied Chemistry & Chemical Engineering, University of Dhaka	DR. M Sarwar Jahan
33	Determination of Chili powder adulteration by Chemometric Analysis of UV-Spectral data	MSc (thesis)	Md. Faizul Islam	Applied Chemistry & Chemical Engineering, University of Dhaka	Dr. Mohammad Nashir Uddin
34	Multivariate analysis for the detection and quantification of different dairy products using FTIR Spectroscopy	MSc (thesis)	Suvasis Shaha	Applied Chemistry & Chemical Engineering, University of Dhaka	Dr. Mohammad Nashir Uddin
35	Monitoring of Butter Oil Adulteration with Palm Oil Using Fourier Transform Infrared Spectroscopy	MSc (thesis)	Amit Chowdhuri	Applied Chemistry & Chemical Engineering, University of Dhaka	Dr. Mohammad Nashir Uddin

Research Fellow:

Sl. No.	Title of research	Research Category	Name of the Student	Name of the Academic Institution/Name of Fellowship	Name of Supervisors
1.	Industrial pollution: levels and types of heavy metals entering into food chain (soil-water-plant continuum) from different industries in and around Dhaka	BCSIR Fellow	Priyanka Dey Shuchi	Dhaka University	Badhan Saha, SO

	city.				
2.	Integrated management of green manures and fertilizer in transplanted aman rice	BCSIR Fellow (PhD)	Zinat Nasrin	BCSIR Labs, Dhaka	John Liton Munshi, PSO
3.	Chemical and Biological Investigation on different Plant parts of <i>Abroma Augusta</i> (L.).	BCSIR Fellow	Tahmina Khondkar Mitu	ICS, BCSIR labs, Dhaka	Dr. Shahin Aziz, SSO
4.	Production of glycosides from <i>Cassia Sophera</i> Linn, a medicinal plant in Bangladesh	BCSIR Fellow	Tahmina Khondkar Mitu	ICS, BCSIR labs, Dhaka	Dr. Shahin Aziz, SSO
5.	Bioanalytical method development and validation of Fexofenadine Hydrochloride and Losartan Potassium in human plasma.	BCSIR Fellow	Farhana Afroz	Prof. Mofizuddin Ahmed Smrity Fellowship	Dr. Md. Hossain Sohrab, PSO
6.	Chemical exploration and identification of bioactive molecules isolated from an endophytic fungus.	BCSIR Fellow	Rabita Zinnuraine	Prof. Mofizuddin Ahmed Smrity Fellowship	Dr. Md. Hossain Sohrab, PSO;
7.	Evaluation of in vitro efficacy of different plant extracts against late and early blight diseases of potato.	BCSIR Fellow	Dr. Sheikh Helena Bulbul	Postdoctoral fellowship	Dr. Md. Hossain Sohrab, PSO
8.	Chemical exploration and identification of bioactive molecules isolated from an endophytic fungus of the plant <i>Adhatoda vasica</i>	BCSIR Fellow (Completed)	Prodip Kumar Baral	Prof. Nurul Afsar Khan Post Graduate Fellowship	Dr. Md. Hossain Sohrab, PSO
9.	Extraction and identification of secondary metabolites isolated from endophytic fungi of <i>Terminalia arjuna</i>	BCSIR Fellow (Completed)	Shanita Zaman Smrity	Prof. Mofizuddin Ahmed Smrity Fellowship	Dr. Md. Hossain Sohrab, PSO
10.	Role of natural antioxidants in high fat diet and adrenaline-induced cardiac hypertrophy.	BCSIR Fellow (PhD Research)	Kazi Jannatul Ferdous	<i>Dr. Quadrat-I-Khuda Doctoral Fellowship</i>	Dr. Md. Hossain Sohrab, PSO
11.	Chemical and Biological investigation of marine endophytic fungi.	BCSIR Fellow	Israt Farha Lini	Prof. Nurul Afsar Khan Post Graduate Fellowship	Dr. Md. Hossain Sohrab, PSO
12.	Isolation of bioactive metabolites from <i>Acacia auriculiformis</i> and its associated endophytic fungi.	BCSIR Fellow	S. M. Jobair Abedin	Prof. Nurul Afsar Khan Post Graduate Fellowship	Dr. Md. Hossain Sohrab, PSO
13.	Isolation of bioactive metabolites from <i>Nymphoides hydrophylla</i> and its associated	BCSIR Fellow	Zihan Rahman Khan	Prof. Mofizuddin Ahmed Smrity Fellowship	Dr. Md. Hossain Sohrab, PSO

	endophytic fungi.				
14.	Pulping & Bleaching of Acacia Auriculiformis (Akasmoni) Planted in Bangladesh	BCSIR PhD Fellow	Md. Moinul Huque	BCSIR	DR. M Sarwar Jahan
15.	Lignin based phenol formaldehyde resin from spent cooking liquor	BCSIR Fellow	Kazi Md. Yasin Arafat	Prof. Nurul Afsar Post-graduate Fellow	DR. M Sarwar Jahan
16.	Application of Chitosan in paper Coating	BCSIR Fellow	Tawhida Akter	Professor Abdullah-Al-Muti Smriti Sharfuddin Post Graduate Fellow	DR. M Sarwar Jahan

**Picture for each Unit/Laboratory:
Developed Products:**



Protein Rich Spirulina in Different By Products (Tablets, Capsule etc.)



Organic Fertilizer (Deodorized Blood Meal)



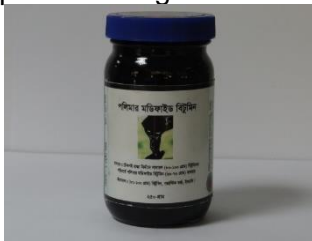
A VEGETABLES DYE PRODUCING PLANTS *BIXA ORELLANA* L



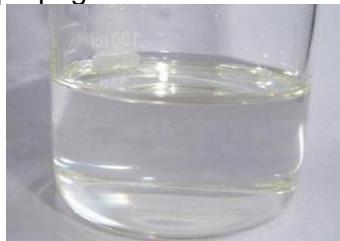
Disease free potato plantlets, microtubers for its large scale commercial exploitation



Development of large scale *in vitro* propagation of calorie free bio-sweetener stevia plants.



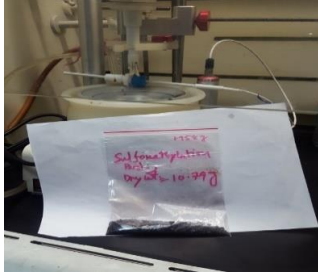
Polymer Modified Bitumen



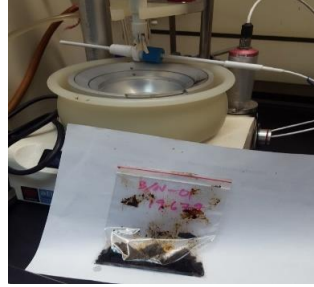
PVC Solvent Cement



Technical lignin



Sulfomethylated lignin



Nitrolignin

Natural dyed fabrics

Major rare instruments:



Low Temperature Incubator



Image Capture Microscope



PCR

PCR machine and ELISA-Reader.



Fluorescent Microscope



RT – PCR



ELISA Reader



Atomic Absorption Spectrophotometer



Ion Chromatograph
Karl Fisher Titration unit



Potentiometric Titrator with



Autoclave



UV-VIS Spectrophotometer



Centrifuge



Ultra-violet Spectrophotometer



Moisture Analyzer



Microwave Digestion System



Size Exclusion Chromatograph



Centrifugal Partition chromatograph



UPLC-MS-MS System



Simultaneous Thermal Analyzer

FT-Raman Spectrometer



Automated Synthesis System

Scientists are working in Fiber and Polymer Research Laboratory:



Visitors of Fiber and Polymer Research laboratory:



Visitors from Bangladesh Navy



Visitors from CSIR-India



Visitors from JICA



Visitors from Bangladesh Army



Visitors from Bangladesh Textile University

Special Allocation Projects:

Development of Analytical Method for Utilization of Waste Materials (Cotton Seeds) in Food industry and in Agricultural sector.

Waste cotton seed contains 15% oil. And cotton seed oil can be a good source of cooking oil (after refining). The seed oil can be treated as cooking oil after removal of toxic material gossypol, a polyphenolic compound. Also oil cake can be used as a biofertilizer in agricultural sectors in our country as it contains various important minerals which can help to increase the growth rate of our agricultural crops.

Objectives:

-
- Findings of the project thus helps to waste product management and thus saves environment pollution to get a green and clean environment.



Crude cotton seed oil



Refined cotton seed oil



Cotton seed oil cake

Work Progress:

- One paper has been published.
- One process has been verified for acceptance.
- One patent has been submitted.

Annual development project:

1. "Institute of Bioequivalence Studies and Pharmaceutical Sciences" was approved by ECNEC on 14th November, 2017
2. Establishment of Genomic Research Laboratory.

Number of Analytical (Ad-Hoc) Problem Solved: During July, 2017 to June, 2018 Scientists of this unit solved 952 Ad-Hoc Problems received from different public and private organization.

BCSIR LABORATORIES, CHITTAGONG

BCSIR Laboratories, Chittagong established in 1965 under the name “Natural Drug Research and Development Institute (NDRDI)”, which was later renamed as BCSIR Laboratories, Chittagong in 1973. It is a multi-disciplinary unit of Bangladesh Council of Scientific and Industrial Research (BCSIR) under the Ministry of Science and Technology. This research organization is headed by a Director and it consists of eight research division viz. Chemical Research Division, Medicinal and Aromatic Plant Research Division, Pharmacology Research Division, Industrial Microbiology Research Division, Phytochemistry Research Division, Soil Management and Agronomical Research Division, Fruits and Vegetables Research Division and Industrial Botany Research Division. Moreover, Hydrogen Energy Laboratory (HETL) is a research Cell of BCSIR dedicated solely to advancing hydrogen energy and fuel Cell technologies. Hydrogen Energy Laboratory (HEL) of BCSIR conduct research on hydrogen production, storage, distribution and hydrogen fuel cell. Hydrogen can be used as fuel and chemical for various purposes. Fuel technology is moving toward to the clean and sustainable hydrogen fuel due to the depletion of fossil fuels. The activities of the HETL are to produce hydrogen using an economic hydrogen production process, developing solid state hydrogen storage materials to store hydrogen safely and hydrogen fuel cell to produce power for stationary application. Our efforts to utilize domestic raw materials and viable technologies to ensure maximum benefit of hydrogen technologies. Moreover, the technology supports and coordinates the traditional fuel technologies to establish a sustainable energy infrastructure. The technologies will contribute to the national grid mix to meet the 15% share of renewables.

R & D Activities:

Biopesticidal product development from *Accacia nilotica* (Bengali: Babla) for agricultural use.

Now-a day's Natural products are more popular to the people of the World because of its fewer side effects. Bangladesh though a small country owing to its favorable climate influences has been blessed with immense natural resource including explored and unexplored natural pesticide plants. There is a great demand of natural and bio-organic pesticides products in the pharmaceutical, agricultural industries in our country.

Proper utilization of these natural plants could be a resource for our socio-economic development. The study will be helpful for the utilization of the medicinal plants like Biskatali, Babla, Kuch, Hijol, Melgola, Bel etc to develop different pesticides products against different types of pesticides.

Objectives

- (a) Utilization of our local medicinal plants to isolate different pesticides compounds.
- (b) To reduce the use of different synthetic pesticide and herbicidal compounds polluting our environment.
- (c) To save our foreign currency by reducing the import of pesticide chemicals.
- (d) To create wealth through scientific research and innovative idea from our local medicinal plants.
- (e) To develop different industrial products which flourish through SME all over the country.

Work Progress:

After collecting the raw materials, different fractions have been extracted using solvents like ethanol, methanol, Petroleum ether, water etc. Extract will be applied on different microbes and food grain pests.

Extraction of natural colors from Asiatic penny Worst (*Centella asiatica*), Jambolan (*Syzygium cumini*), Gum Arabic tree (*Acacia nilotica*), Common bean (*Phaseolus Vulgaris*) and Red Spinach (*Amaranthus dubius*) for using in food industry

Synthetic colorants have long been used for the aforementioned purposes due to their stability, diverse hue variation and vibrant color. Unfortunately, consumption of synthetic colorants has been reported to be related to many adverse health effects, e.g., hyperactivity, Irritability, sleep disorders and aggressiveness. Use of natural colorants as well as colorants produced from natural sources has thus gained increasing popularity, especially during the past few years. Proper utilization of these natural colors could be a resource for solving our health problem and contributing our socio-economic development.

The study will be helpful for the utilization of the local plants like Asiatic penny worst, Jambolan, Gum Arabic tree, Red Spinach and Common Bean to produce different Natural Color compounds and their health effects.

Objectives:

- a) Utilization of our local plants to isolate different Natural colors for using in food and beverages.
- b) To reduce the use of different synthetic colors toxic effects on our food and beverages.

- c) To save our foreign currency by reducing the import of color compounds.
- d) To solve health problems like diabetes, aging, cancer and free radical scavenging of using those color compounds as by product of food and beverages.
- e) To develop different industrial products using those color compounds which improving our food habits all over the country.

Work Progress:

Raw materials have been collected and extraction of different organic color fraction using different solvents has been done.

Products development from natural rubber latex (NRL).

Natural rubber latex (NRL) extracted from *Hevea brasiliensis* (Rubber tree) is a colloidal system containing 50-55% of water, 4-5% of nonrubber (as proteins, lipids, etc.), and 30–45% of rubber particles (mainly cis-1,4-polyisoprene). In Bangladesh, we are endowed with huge resources of flora including *H. brasiliensis* (Rubber plant). More than hundred of products may be derived from raw rubber (latex). But it is a matter of great sorrows that we import a large amount of rubber products per year from foreign countries. In Bangladesh, latex is collected from east-southern part of the country such as from Chittagong, Cox-bazar, Khagrachori and Rangamati, which are exported as ribbed smoked sheet to the foreign countries. Lacking of proper technology and method, we are deprived from the scope of rubber goods production. Rubber is imported as auto tyre tubes, gloves, rubber bands, elastic, foot ware and textile fabricating material etc. In this project, we will develop some processes which will carry out at a pilot scale in order to make all free, azo free products for painting purposes in garments items and designing coating material for roof and others valuable products using latex. Improved methods for the processing and preservation of raw rubber (latex) and new techniques for quality assessment will be developed.

Objectives:

Search for new azo and all carcinogenic free painting materials for the fabrication of textile fabric, designing material and others valuable product etc.

- ◆ To develop azo free rubber compound for the textile fabricating material.
- ◆ To develop all free rubber compounds for the production of textile designing material.
- ◆ To develop others valuable product from raw rubber (latex) etc.

Work Progress:

One research article has been submitted for publication as a full paper.

Application of computer modeling in the evaluation of naturally occurring anticancer compounds: A Step towards Drug Discovery from Bangladeshi Medicinal Plants

The project aimed on the development of experimental evidence based database of Bangladeshi medicinal plant derived molecules for future nature inspired rational drug design and discovery. As a result, a dedicated web based molecular archive has been developed, GreenmolBD.

GreenmolBD is a freely available electronic database containing detailed information about small molecule metabolites found in the Bangladeshi medicinal plants. The database is designed to contain or link three kinds of data:

- a) Compounds
- b) Medicinal plants, and
- c) Diseases data

Objectives:

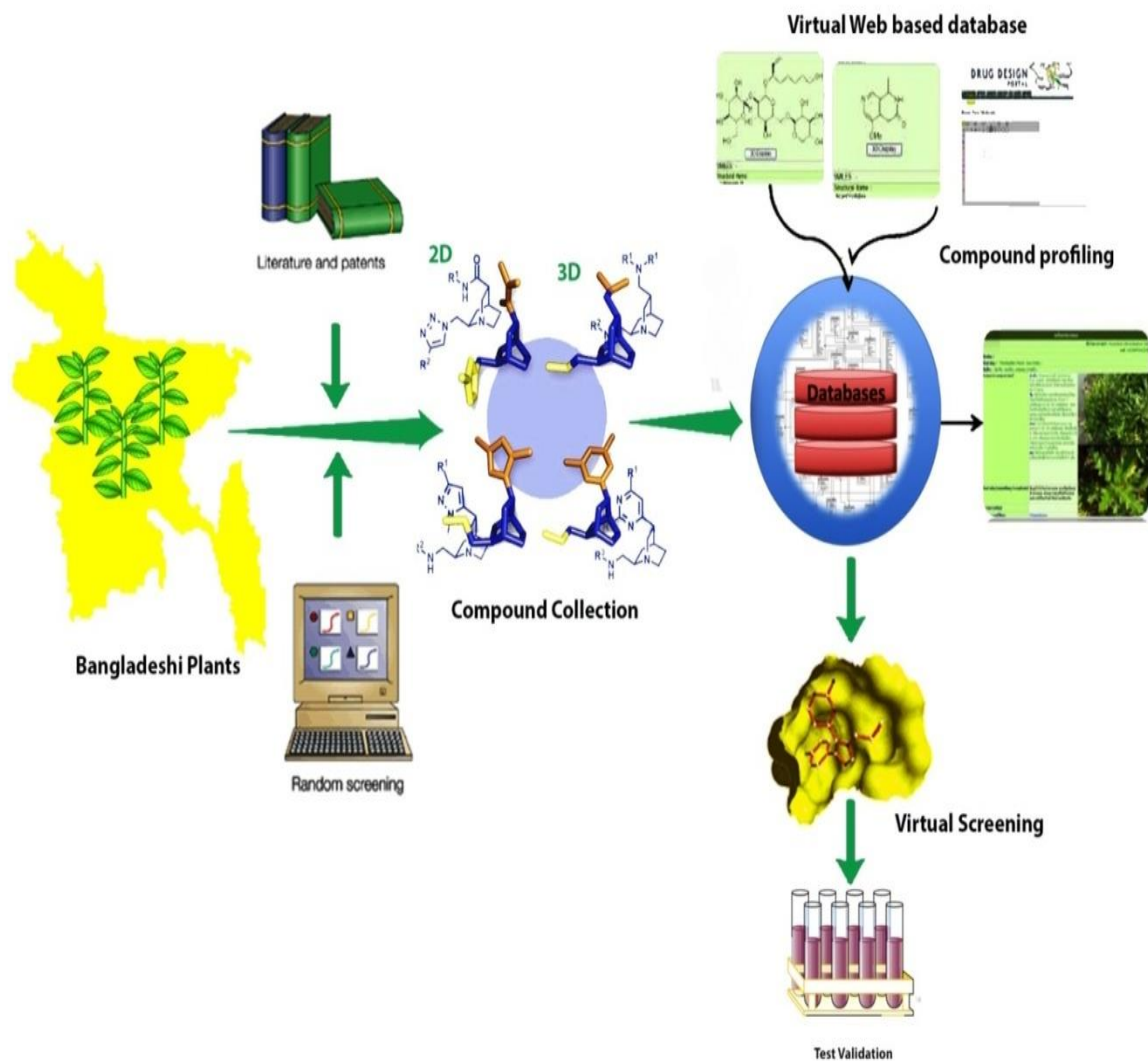
The GreenmolBD Database is intended to be used for applications in drug discovery and general education

Work Progress:

- i) The database contains more than 145 Bangladeshi medicinal plants with 6,837 naturally occurring compounds with all calculated descriptor necessary for future nature inspired drug discovery by exploiting these resources.
- ii) All the traits of the websites soon will be available for the end user in drug discovery research arena.

Data and Pictures of respective R&D activities:

For Data, Website Link :<https://greenmolbd.com/>



Nature Derived Bioactive Molecule Database of Bangladesh

[Plant](#)
[Compound](#)
[Target](#)
[Disease](#)

Search Plant by name, synonym, common name or family

Welcome to GreenmoIBD, Nature Derived Bioactive Molecule Database of Bangladesh

GreenMoIBD is a freely available electronic database containing detailed information about small molecule metabolites found in the Bangladeshi medicinal plants.



32

Total No. of Plants



6,837

Total No. of Compound



216,280

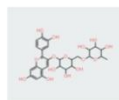
Total No. of Compound Synonym

Plant of the Month



Abelmoschus esculentus (L.) Moench
Family Malvaceae
Synonyms Hibiscus esculentus L.
Number of Compound 134

Compound of the Month



Cyanidin-3-rutinoside
Molecular Weight 595.53 g/mol
Molecular Formula C₂₇H₃₁O₁₅
Exact Molecular Mass 595.166

New Plant



Leucos aspera
Family Lamiaceae
Synonyms
Total Compound 142

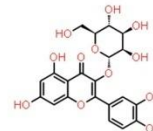
Citations

Human Rotavirus Genotype G Detection among Hospitalized Children in Yunnan
Wu J., Zhou Y., Yi S., Zhang G., Yin N., Xie Y., Peng M., Mi K., Xiao N., Li H. et al. Submitted (JUL-2014) to the EMBL/GenBank/DBJ databases - UniProtKB (23)
Wu J., Zhou Y., Yi S., Zhang G., Yin N., Xie Y., Peng M., Mi K., Xiao N., Li H. et al. Submitted (JUL-2014) to the EMBL/GenBank/DBJ databases - UniProtKB (23)

Quercetin 3-O-glucoside

GreenMolBD CID : 1
Molecular Formula : C₂₁H₂₀O₁₂
Molecular Weight : 464.379
Exact Molecular Mass : 464.095
IUPAC Name : 2-[(3,4-dihydroxyphenyl)-5,7-dihydroxy-3-[[[2S,3R,4S,5S,6R]-3,4,5-trihydroxy-6-(hydroxymethyl)oxan-2-yl]oxy]chromen-4-one
InChI : InChI=1S/C21H20O12/c22-6-13-15(27)17(29)18(30)21(32-13)33-20-16(28)14-11(26)4-8(23)5-12(14)31-19(20)7-1-2-9(24)10(25)3-7/h1-5,13,15,17-18,21-27,29-30H,6H2/t13,15-17+,18-,21+/m1/s1
InChI Key : OVSQVDMCBVZWGM-QSOFNLRSA-N
Canonical SMILES : C1=CC(=C(C=C1)C2=C(C(=O)C3=C(C=C(C=C3O2)O)OC4C(C(C(C(O4)CO)O)O)O)O
Isomeric SMILES : c1cc(cc1c2c(c(O)c3c(cc3o2)O)O)[C@H]4[C@@H]([C@@H]([C@H]([C@@H]4O)CO)O)O)O
Cross Reference : Pubchem

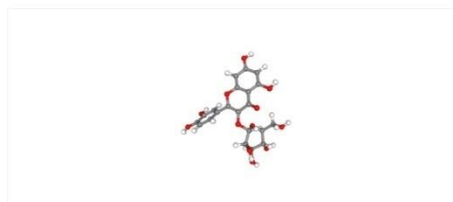
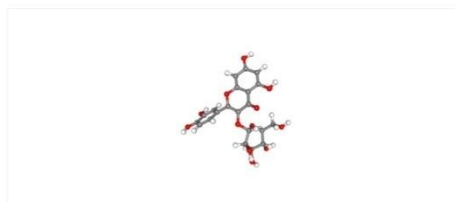
3D Structure 2D Structure Downloads



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9. Compound in Different Plants
10. Targets
11. Chemical Vendors

1. Structure Download

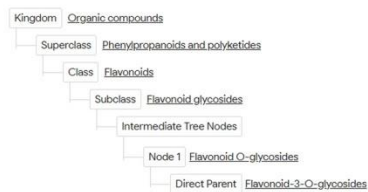


2. Classification

2.1. Description

This compound belongs to the class of organic compounds known as flavonoid-3-o-glycosides. These are phenolic compounds containing a flavonoid moiety which is O-glycosidically linked to carbohydrate moiety at the C3-position.

2.2. Taxonomy Tree



2.3. Alternative Parent

Show 10 entries

Search:

Name
1-hydroxy-2-unsubstituted benzenoids
1-hydroxy-4-unsubstituted benzenoids
3'-hydroxyflavonoids

Abelmoschus esculentus (L.) Moench

Family: Malvaceae

Synonyms

Hibiscus esculentus L.

Family Synonyms

Common Names

Dheros; Vendí (Chittagong), Lai Long Ma (Murong), Lady's finger; Okra, Gumbo.

Local Availability

Sylhet, Chittagong hill tracts and Northern districts in fallow lands and forest outskirts.

Worldwide Availability

West African, Ethiopian, and South Asian origins. The plant is cultivated in tropical, subtropical and warm temperate regions around the world

Botanical Description¹⁹

Abelmoschus esculentus (L.) Moench is covered with rough hairs, is a tall shrubby, and annual. Leaves are the lower roundish-angled, are polymorphous. The upper leaves are palmately 3-5-lobed, while the

Common Ethnobotanical Use²⁰

Fruits are useful in gonorrhoea, urinary discharges, strangury and diarrhea; are also known as cooling, stomachic, astringent and aphrodisiac; used in chronic dysentery. In the form of decoction, tender pods are employed as an emollient, emollient and diuretic, and also are eaten in spermatorrhoea. The whole plant is also used as a valuable emollient and demulcent.



Chemical Constituents

Show 10 entries

Search:

Compound Name	Compound in Plant Parts	Reference
1,2-Diethylbenzene	Pod	3
1,2-Dimethoxybenzene	Pod	3
1,8-Cineole	Pod	3
1-Methylnaphthalene	Pod	3
2,3-Dihydrobenzofuran	Pod	3
2,3-Dimethylpyrazine	Pod	3
2,5-Dimethyl-3-ethylpyrazine	Pod	3
2,5-Dimethylfuran	Pod	3
2,5-Dimethylpyrazine	Pod	3
2,5-Dimethylthiophen-3-carboxaldehyde	Pod	3

Showing 1 to 10 of 135 entries

< 1 2 3 4 5 ... 14 >

Pharmacological Evidence

Plants Parts	Extract Type	Activity	Reference
Flower	Ethanol	Liver Cancer	11
Lactin	Ethanol	Gastroprotective	17
Peel and seed powder	N/A	Antidiabetic	15
Pod	Aqueous	Antibacterial	14
Pulp	Aqueous	Leukemic	9
Root	Methanol	Analgesic	18
Seed	N/A	Breast Cancer	10
	Aqueous	Antifungal	12
	Ethanol	Antibacterial	13
	Methanol	Analgesic	16
	Methanol	Antiinflammatory	16
Methanol	Methanol	CNS Activity	16

References

- Shui, G. and Peng, L.L. (2004) An improved method for the analysis of major antioxidants of *Hibiscus esculentus* Linn. *Journal of Chromatography A*, 1048, 17-24.
- Arapitsas, P. (2008) Identification and quantification of polyphenolic compounds from okra seeds and skins. *Food Chemistry*, 110, 1041-1045.
- Ames, J.M. and Macleod, G. (1990) Volatile components of okra. *Phytochemistry*, 29, 1201-1207.
- Jia, L., Guo, M., Li, D. and Jing, L. (2010) Chemical constituents from petroleum ether portion of *Abelmoschus esculentus* L. *Zhongguo Zhong yao za zhi*= *Zhongguo zhongyao zazhi*= *China journal of Chinese materia medica*, 36, 891-895.
- Jia, L., Li, D., Jing, L. and Guo, M. (2010) Studies on the chemical constituents from petroleum ether portion of *Abelmoschus esculentus*. *Zhong yao cai*= *Zhongyao cai*= *Journal of Chinese medicinal materials*, 33, 1262-1265.
- Onakpa, M. (2013) Ethnomedicinal, phytochemical and pharmacological profile of genus *Abelmoschus*. *Phytochemistry*, 4, 648-663.
- Jia, L., Li, H. and Jing, L. (2010) Chemical constituents in n-butanol extract of *Abelmoschus esculentus* L. *Zhongcaoyao*= *Chinese Traditional and Herbal Drugs*, 41, 1771-1773.

Isolation and structure elucidation of bioactive constituents from endophytic fungi of a local medicinal plant *Blumea lacera* with anti-diabetic potential.

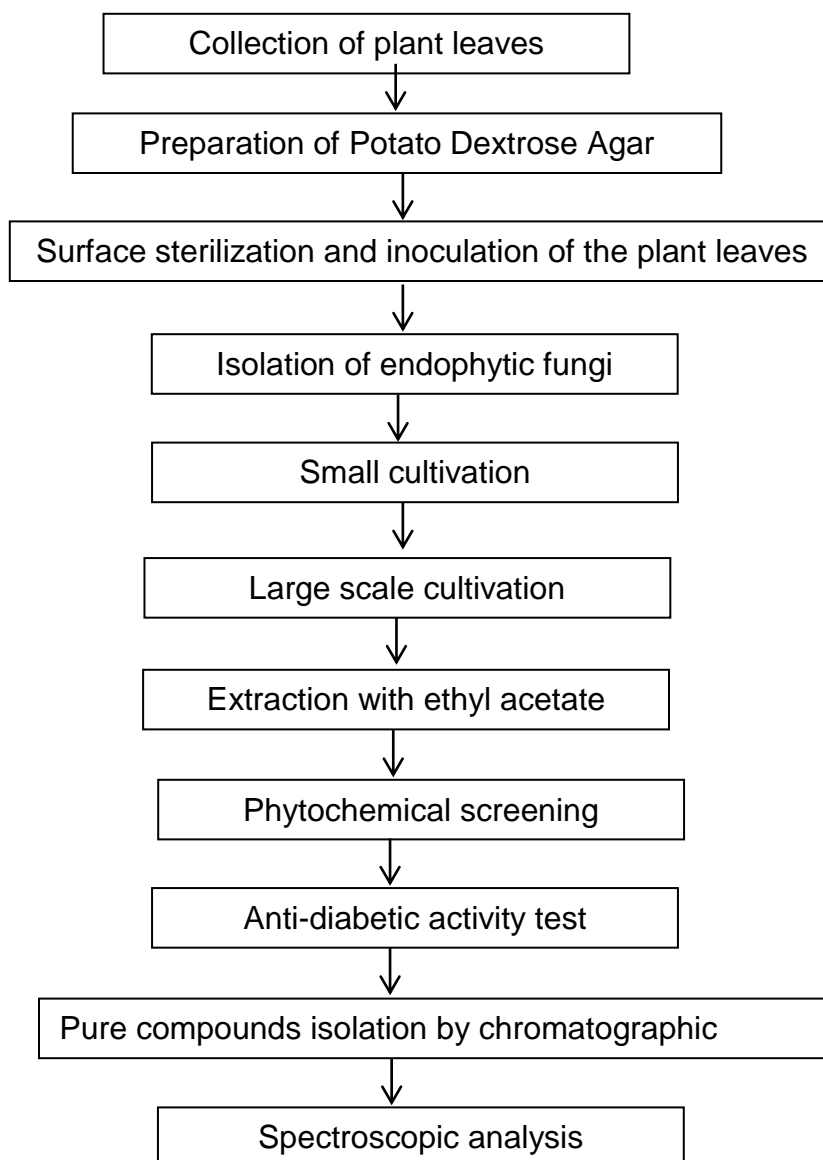
Endophytic fungi are known to produce some rare and novel natural agents with notable pharmacological activities. This project involves pharmacological screening program of the endophytic fungal diversity from the local plants and assess their potential bioactive constituents. This may lead to the isolation of natural compounds which may serve as important bioactive leads to produce more potent and safer drugs.

Objectives:

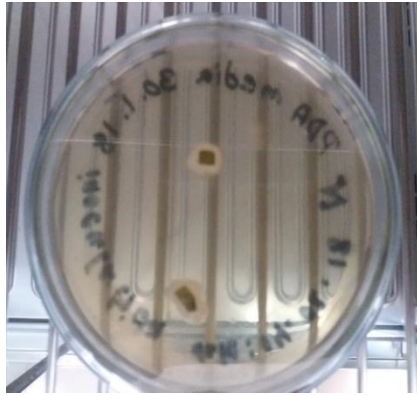
1. To tap the Endophytic fungal diversity from the local plants and assess their potential bioactive constituents.
2. To search for natural novel bioactive compounds, with potential use in drug discovery

Work Progress:

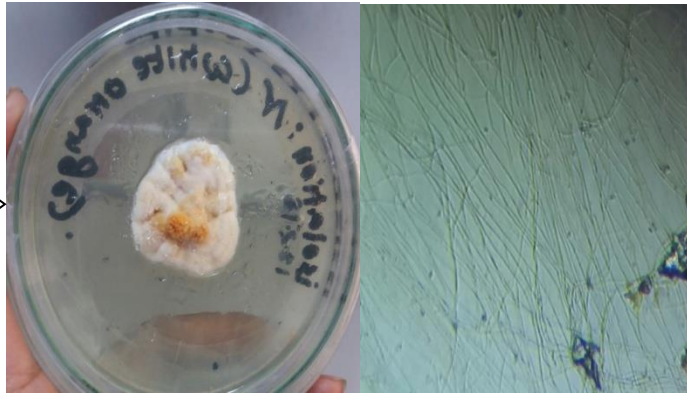
1. Sample collection and identification is done.
2. Five fungal species are isolated.
3. Small scale culture has been done.
4. Large scale culture is going on.
5. Single compound isolation is going on.

05. Methodology:

Overall view:

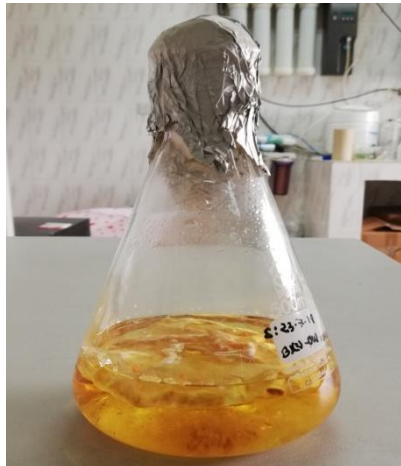


Inoculation



Isolated fungus

Microscopic view



Large scale culture in PDB



Small scale culture in PDA

Hydrogen fuel production from SQNG (sub quality natural gas)

The use of alternative and renewable sources of power production is now mainstream concept in the global energy discussion. Hydrogen has the potential to provide energy for stationary conversion devices such as fuel cells, as well as for transportation needs, such as those used on a farm, at a port. Hydrogen Production using sub-quality natural gas (SQNG) support energy and fuel sector for sustainable future.

Objectives:

- 1) To Produce Hydrogen using sub-quality natural gas (SQNG).
- 2) To develop catalyst and optimize the processes conditions of hydrogen production.
- 3) To study the reaction mechanism of the hydrogen production.

Work progress:

- Pyrolyser fabrication completed.
- Lab scale molecular Sieves developed or synthesized.
- Review article submitted. "Prospect of molecular sieves production using rice husk of Bangladesh: A review."



Achievements:

Research Papers:

Uddin M. N., Uddin M., Kabir T. and Das S., "New Validated UPLC Method for the Determination of Tiemoniummethylsulphate in Pharmaceutical and Biosamples", Pharm Pharmacol Int J., 5(2), 01-17, 2017.

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Das P.K., Das S., Morshed A.J.M., Chakraborty D., Sabuj M. R. H., Bhattacharjee S. C. and Bhuiyan H. R. "Toxic Metal and Essential Nutrients Concentration in Different Vegetables Collected from Market Sites of Chittagong Metropolitan City, Bangladesh." *Current World Environment*, 12 (2), 270-277, 2017.

Uddin M. N., Uddin M., Kabir T. and Das S., "Estimation of Ketorolactromithamine in Pharmaceutical samples and biofluids by the new validated UPLC method"., *J. Pure App. Chem. Res.*, 6(2), 137-149, 2017.

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Ahmed M. S., Rahmatullah Md. and Khan Md. A. A., Hydrocarbon gas generation by biochemical process of moderately barophilic methanogens in Barapukuria coal mine gas reservoir & aquifer, *FUEL*, 210, 121-132, 2017

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Uddin M. N., Das S., Md Mijan NH., Md. Al-Amin. and Bhuiyan HR., "Simultaneous Determination and Mutual Interaction Study of Ciprofloxacin and Chloramphenicol in Concomitant Administration by a New UPLC Method "., *Pharm Anal. Acta.*, 8(1), 535, 2017.

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Sikandera U., Sufiana S. and Salam M. A., "A review of hydrotalcite based catalysts for hydrogen production systems", *International Journal of Hydrogen Energy*" 42 (31), 19851-19868, 2017.

Salam M. A., Abdullah B. and Islam M. A., "Temperature programmed analysis of hydrogenation and dehydrogenation of magnesium (Mg), nickel (Ni) and aluminum (Al) containing mixed oxides", *Chemical Engineering Research and Design*, DOI: <http://dx.doi.org/10.1016/j.cherd.2016.10.039>, ISI and SCOPUS INDEXED, IF=2.5, 118, 103-111, 2017.

Salam M. A. and Sufian S., "A DFT Study of Hydrogen Adsorption Kinetics and Thermodynamics on Mixed Oxides of Mg_{0.5}Ni_{0.25}O_{1.13}", *Journal of Engineering and Applied Sciences*, 12, 4431-4436, 2017.

Awad A., Salam A. and Abdullah B., "Hydrogen Production by Decomposition of Methane and Methanol Mixture over Ni-Pd/Al₂O₃", Journal of the Japan Institute of Energy, 96, 445-450, 2017.

Scientists pursuing M.S/M. Sc./Ph.D. courses in home or abroad:

a) Name : Irin Hossain
Designation : Doctoral Fellow
Division : Hydrogen Energy Technology Laboratory
Department : Chemistry
University/Institute : University of Chittagong
Supervisor : (i) Prof. Dr. Shamim Akhter (ii) Prof. Dr. Ismail Hossain
Thesis Title : Phytochemical Properties of Hydroxyl Ammonium-Based Protic ionic liquid and their binary mixtures with isomeric alkaloids.
Duration : April, 2017 – April, 2020

b) Name : Jewel Das
Designation : Scientific Officer
Division : Chemical Research Division
Deputation : 15.10.2016 to 28.04.2018
Awarded Degree : M.Sc. in Environmental Science
(Specialization: Environmental Science and Technology)
Department : Environmental Engineering and Water Technology
University/Institute : UNESCO-IHE Institute for Water Education, Delft,
The Netharlands
Supervisor : Professor Eric D. van Hullebusch
Thesis Title : Performance of a compost and biochar packed biofilter for gas-phase H₂S removal.

3. Academic Research Guidance/Supervision:

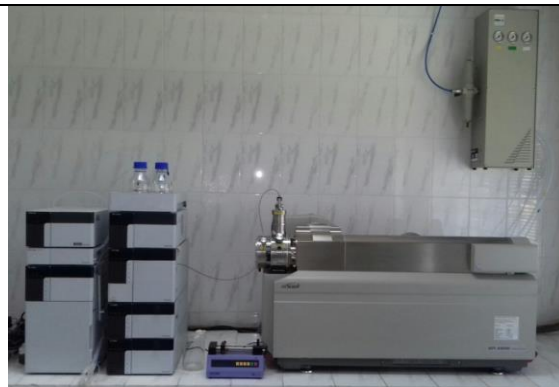
Sl. No	Title of the Research	Research category (PhD/M. Phill /M.S)	Name of the Students	Name of the academic Institution	Name of the Supervisors in BCSIR
01	Determination of different physicochemical parameters	B. Sc. (Hons')	Hillol Ghosh, Shanta Chowdhury	Chittagong Veterinary and Animal Sciences	Prabhangshu Kumer Das, Scientific Officer

	tests of water			University	
02	Development of value added products from Pineapple	B. Sc. (Hons')	Akib Ziauddin Chowdhury, Sultan Mohammad Adnan, Rimon Barua, Arnab Chakraborty, Shahidur Rahman	Chittagong Veterinary and Animal Sciences University	Sreebash Chandra Bhattacharjee, Senior Scientific Officer
03	Catalytic reaction mechanism of Hydrogen fuel cell and its environmental impact	M.Sc thesis	Abrar Hasan	University of Chittagong	Dr. Md. Abdus Salam Senior Scientific Officer Hydrogen Energy Lab.

Product pictures:

		
Stevia Sweetner	Oil of Japanese mint	Leaf oil of Turmeric

Modern Equipments



BCSIR Laboratories, Rajshahi



The main objective of the BCSIR laboratories, Rajshahi, is to provide support to the industrialization and socio-economic development of the country through establishment of a Center of Excellence in science and technology research. Through the successful application of innovations, this laboratory is supporting the establishment of available agricultural raw materials based industries in the northern region of the country. The processes developed by BCSIR laboratories, Rajshahi, are leased out to the entrepreneurs through the Council for commercial use. Coordinated initiatives are taken to identify and solve the technical problems of the industries. Arrangement of MoU between the local and international research institutes and universities were done to promote research quality. More than 3,000 research articles have been published from the BCSIR Laboratories, Rajshahi, 160 innovative techniques have been adopted, 132 patents have been acquired and 38 technologies have been handed over to industrialists. Significant technologies that are developed for commercial production in industrial factories are: Dewaxed Shellac Flakes, CMC, Aloe Vera Powder, Powdered Mango, Aloe Vera Body Lotion, Herbal Anti Fungal ointment, Amalaki Powder Drinks, Herbal After Shave Lotion, Aloe Lemon Drinks, Aloe shampoo etc. The laboratories are contributing to the trade through providing international standard product analysis services, supporting to the export and import, providing services to industries and individuals. Latest technologies like real-time PCR, LCMS, AAS, Ion-trap MS, etc., is being used to provide analytics services such as Halal detection, GMO's presence detection, Gene Expression, Bird flu detection, Analysis of Various Antibiotics, Vitamins, Amino Acid, Heavy Metals etc. Most of the imported products through Benapole and Sonamasjid land port are analysed by the BCSIR laboratories, Rajshahi.

Fibre and Polymer Research Division, BCSIR Laboratories, Rajshahi.

R&D Activities:

Natural dye from the indigenous plant materials and their different application.

Natural dyes are eco-friendly, hygienic & human skin friendly. The manufacturing and application of these dyes are subject to least environmental problem. In comparison to natural dyes, synthetic dyes are reported to cause skin & other diseases. Moreover the manufacturing and application of synthetic dyes create environmental pollution like water pollution, air pollution. Now more research work should be done to find the alternative of these synthetic dyes.

Objectives:

1. Isolation of eco-friendly natural dye from various indigenous source, e.g. Khair (*Acacia catechu*), Lotkon (*Baccaurea ramiflora*), Mehedi (*Lawsonia inermis*), Coconut (*Cocos nucifera*), Mulberry fruits (*Morus nigra* L.), Babla Fruits (*Acacia nilotica*) etc.
2. Application of the dye on textile, food etc.
3. To protect the environmental pollution caused by the synthetic dye.

Work progress:

- A process of water soluble natural dye from Khair has been verified.
- Natural dye from green coconut shell has been prepared and its different application to fibre (Silk, Cotton & Jute) is going on.
- Two (02) papers have been published.

5) All data and pictures of respective R&D activities:

Some pictorial representation of R&D project:

Water soluble Vegetable Dye from green coconut shell has been prepared.



Drugs and Toxins Research Division

R & D Activities

Isolation and Phytochemical screening of biologically active compound from different types of oil seeds to find out lead compounds.

The history of the extraction of natural products dates back to Mesopotamian and Egyptian times, where production of perfumes or pharmaceutically active oils and waxes was a major business. Biologically active Natural products are synthesized in the plant cell to fulfill the plants own needs: some are antimicrobial, some antioxidant, some are antifeedant, some are cell signaling molecules, some are PCD inducer and so on. Seeds, Fruit peels, Barks, Leafs, Roots, flowers etc. is a rich source of some particular kind secondary metabolites. For example oils seed are rich source of different types of Lignan molecules. Fixed oils contain the oil soluble lignan molecules and the corresponding oil cakes contain the water soluble lignan molecules. So the main objective of the project is to isolate and quantify the lignan or secondary metabolites of any kind like Alkaloids, Glycosides, Flavonoids or fatty acids having pharmacological importance from oil seeds mentioned bellow-

Dried coconut, Linseed, Neem seed, Castor Bean (Vanna), Lemon seed, Peanut, Hasti Polas seed (Leea macrophylla). Pmpkin Seed, Nagessor (Mesua ferrea), kalizeera (Nigella sativa) etc.

Objective

Creation knowledge in the from research paper and development of domestic technology after successful completion of the project that will open up the door for the utilization of locally available raw materials, create new employment, alleviate poverty, and improve the socio-economic condition of the people which will have a profound impact on national economy.

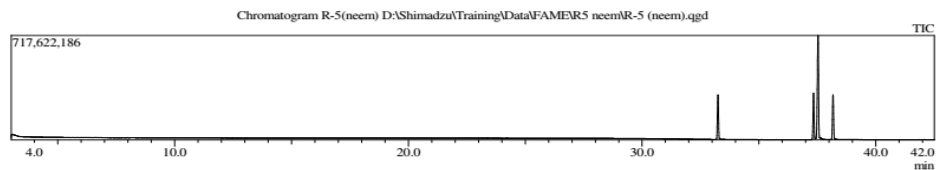
Work Progress

- ❖ Some necessary raw materials have been collected
- ❖ Extraction of oil has been done (Picture bellow)



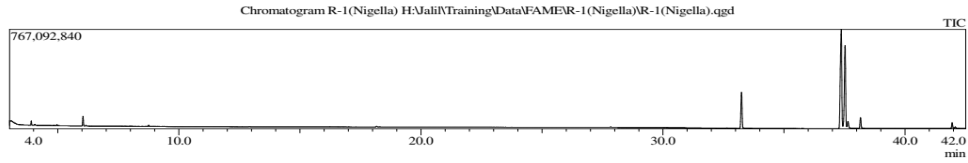
Scenic View of oil Extraction

- ❖ Data of R & D
- ❖ activities (Figures below).



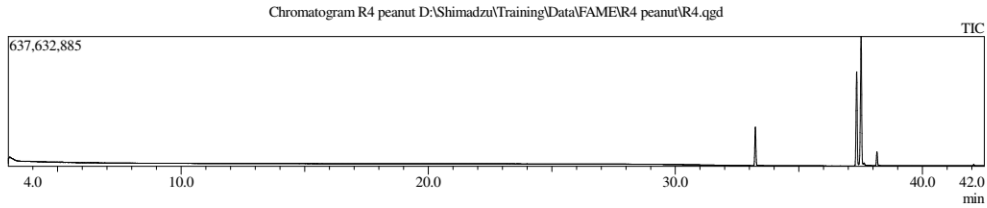
ID#	Name	R.Time	m/z	Area	Conc.	Conc.Unit
1	Methyl octanoate(caprylic acid)	8.779	39.00	282976	0.215	%
2	Methyl decanoate(capric acid)	15.386	59.00	8885	0.007	%
3	Methyl laurate(lauric acid)	21.920	60.00	20184	0.015	%
4	Methyl tetradecanoate(myristic acid)	27.829	211.00	19439	0.015	%
5	Methyl palmitate(palmitic acid)	33.249	76.00	15223067	11.523	%
6	Methyl linoleate(linoleic acid)	37.327	67.00	40245097	30.464	%
7	cis-9-oleic acid methyl ester (oleic acid)	37.521	109.00	36419249	27.568	%
8	Methyl octadecanoate(stearic acid)	38.152	55.00	39664096	30.148	%

Neem Seed's Oil



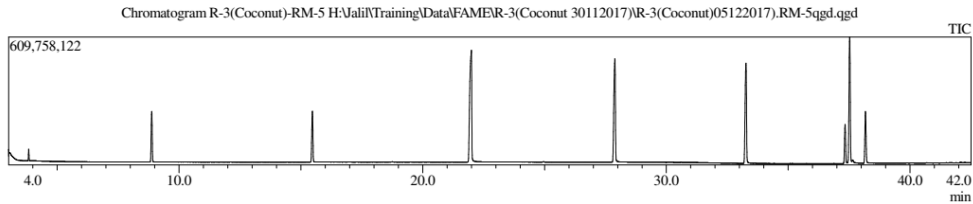
Quantitative Result Table

ID#	Name	R.Time	m/z	Area	Conc.	Conc.Unit
1	Methyl octanoate(caprylic acid)	8.753	39.00	1000611	0.802	%
2	Methyl decanoate(capric acid)	15.452	59.00	18095	0.014	%
3	Methyl laurate(lauric acid)	21.856	60.00	115677	0.093	%
4	Methyl tetradecanoate(myristic acid)	27.840	211.00	94521	0.076	%
5	Methyl palmitate(palmitic acid)	33.238	76.00	13729376	10.999	%
6	Methyl linoleate(linoleic acid)	37.311	67.00	61874078	49.570	%
7	cis-9-oleic acid methyl ester (oleic acid)	37.522	109.00	32699856	26.197	%
8	Methyl octadecanoate(stearic acid)	38.157	55.00	15289456	12.249	%



Quantitative Result Table

ID#	Name	R.Time	m/z	Area	Conc.	Conc.Unit
1	Methyl octanoate(caprylic acid)	8.951	39.00	54333	0.058	%
2	Methyl decanoate(capric acid)	15.645	59.00	38339	0.041	%
3	Methyl laurate(lauric acid)	21.901	60.00	14423	0.015	%
4	Methyl tetradecanoate(myristic acid)	27.750	211.00	8574	0.009	%
5	Methyl palmitate(palmitic acid)	33.236	76.00	3018286	3.379	%
6	Methyl linoleate(linoleic acid)	37.507	67.00	43070965	47.891	%
7	cis-9-oleic acid methyl ester (oleic acid)	37.518	109.00	31267908	34.967	%
8	Methyl octadecanoate(stearic acid)	38.155	55.00	11873594	13.289	%



Quantitative Result Table

ID#	Name	R.Time	m/z	Area	Conc.	Conc.Unit
1	Methyl octanoate(Caprylic acid)	8.877	127.00	28692314	8.354	%
2	Methyl decanoate(Capric acid)	15.463	88.00	28646920	8.341	%
3	Methyl laurate(Lauric acid)	21.966	76.00	55385918	16.122	%
4	Methyl tetradecanoate(Myristic acid)	27.857	83.00	45299978	15.724	%
5	Methyl palmitate(Palmitic acid)	33.246	74.00	63053129	18.349	%
6	Methyl linoleate(Linoleic acid)	37.338	67.00	34589500	10.069	%
7	cis-9-oleic acid methyl ester(Oleic acid)	37.538	87.00	43046646	12.524	%
8	Methyl octadecanoate(Stearic acid)	38.156	87.00	44922959	13.073	%

Coconut's Oil

Applied Zoology Research Division

R & D Activities

Development of Culture Technology for Insect larvae as Live Fish Feed.

Food security is a global challenge. As overall demand for food particularly meat increases, there is an urgent need to increase supply of protein from sustainable sources. Insects, especially flies, have the potential to help meet this demand. As fly larvae is a natural component of the diet of fish, chicken and pig, the proposed research is focusing on rearing two species of fly (for example, house fly and black soldier fly) and conducting feeding trials with their larvae or maggots. Fly larvae grown on a range of organic wastes have the ability to reduce the volume of that waste by up to 60%, providing an additional benefit to waste management and the environment. The present research will evaluate the quality and safety of the larvae produced for incorporation into fish feed, as well as the taste and texture of the meat produced. Research findings encourage and enable the adoption of fly larvae protein into animal feed around the world. Insect rearing could be one of the ways to enhance food and feed security (Van. Fly larvae grow and reproduce easily, have high feed conversion efficiency (since they are cold blooded) and can be reared on bio-waste streams. One kg of insect biomass can be produced from on average 2 kg of feed biomass. Insects can feed on waste biomass and can transform this into high value food and feed resource. Veldkamp et al. (2012) has demonstrated that it is technically feasible to produce insects on a large scale and to use them as alternative sustainable protein rich ingredient in pig and poultry diets, particularly if they are reared on substrates of bio-waste and organic side streams.

Objectives

- ❖ To develop mass culture method for insect larvae (i.e. Diptera larvae) as live fish feed.
- ❖ To investigate the impact of maggot (fly larvae) on fish food habit of indigenous carnivorous fishes.
- ❖ Further research on introduction of a new diet, development of culture method of insect larvae through organic waste management system.
- ❖ To analyze biochemical components of both feed and fish.
- ❖ Investigate on high yielding varieties of insect which is suitable for commercial culture and improvement of indigenous insect larvae by crossbreeding.

Work Progress:

Two fly species are identified for rearing including *Musca domestica* and *Hermetia illucens*. We are trying to develop culture media for insects. One paper is ready for publish.

Pictures:



Live Black Soldier Larvae



Dry Black Soldier Larvae



Adult Black Soldier Larvae



Pupae of Black Soldier Larvae

Fruits and Food Processing and Preservation Research Division

R & D Activities

preservation Technology, Yield and Quality Characteristic of Different Jackfruit Cultivars Grown at Rajshahi Region of Bangladesh.

Bangladesh is a jackfruit producing country and also it is a national fruits of Bangladesh. In Bangladesh, Rajshahi (Northern part of the country) is enriched with many delicious and nutritious fruits. The climatic condition of the place is suitable for the production of quality fruits. Of them, jackfruit is the principal fruit crop and plenty of jackfruit are grown here. As a result, Rajshahi meets up 40% of the demand of total national requirement. The production of jackfruit is highly threatened by various factors such as improper nourishing, deficiency of plant nutrients and inadequate knowledge of appropriate fruits technology and also preservation technology. The growers and the entrepreneurs want to make it available all over the year. Considering this problem, the present study has been undertaken to overcome the problem faced thereby making availability of raw materials (jackfruit) for setting up jackfruit based industries throughout Bangladesh. The grower will get maximum benefit by feeding the jackfruit to the local industries and will also be encouraged to grow more and more this type of fruits. This will generate employment, alleviate poverty and of course, have a profound impact on our national economy.

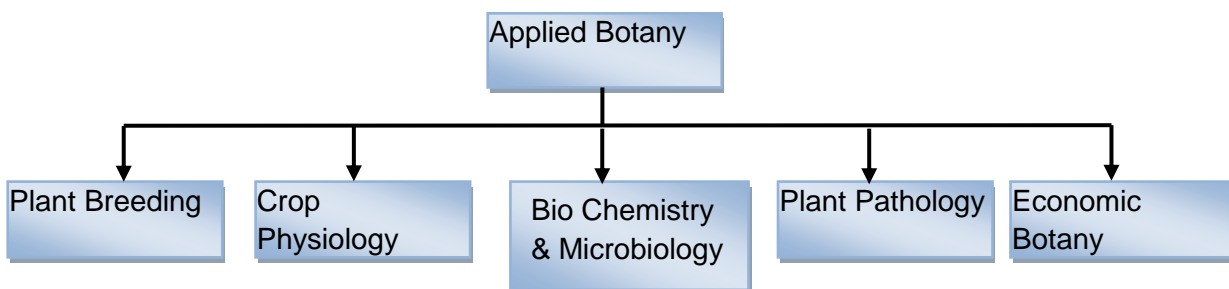
Objectives

1. To enhance the yield of different jackfruit cultivars.
2. To enhance the early and also delaying maturity of jackfruit cultivars.
3. To improve the quality of different jackfruit cultivars.
4. To reduce the post harvest losses of jackfruit cultivars.

Progress

Research Paper published: Studies on the storage life and quality characteristics of ripe jackfruit (*Artocarpus heterophyllus* Lam). Drinks of local cultivar grown in Rajshahi region of Bangladesh. *Int. J. Sustain. Agril. Tech.* 13(8): 01-08, August 2017.

Name of Unit: Applied Botany Research Division.



R&D Activities

Investigation of plasma technology to germination rate, growth rate, production rate, and anti-fungal activities on potatoes (crops) during post- and pre-harvest.

Brief Description: Plasma is generally called 4th state of matter. It is ionized state of gas molecules or atoms and these ionized species are able to create reactions on the samples surface. Plasma technology has a great interest for researcher in recent years in agriculture sector for the enhancement of seed germination plant growth and yield as well as disease control. Low temperature plasma are used in treatment of living tissue, bacterial and fungus inactivation, food preservation, plasma medicine, water purification etc.

Objective:

- Development of new technology to improve crop production in Bangladesh.
- Production of quality crop through eco-friendly technique.
- A way to increase seed germination, growth and yield.
- Development of technologically skill man power.

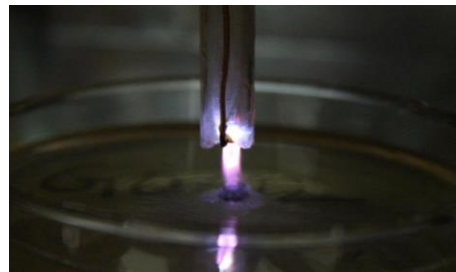
Progress

Low temperature plasma has been successfully applied for potato seed treatment. The effects of plasma treatments on potato have been observed in both laboratory and field condition. Besides, antifungal activities of plasma on potato have also been investigated.

Picture of R & D activities



Potato seed treatment with glow discharge air plasmas



Gliding arc discharge (GAD) plasma (H₂O/O₂) treatment for the destruction of *Fusarium oxysporum*



Plasma treatment for controlling potato disease in the field



Plasma treatment for controlling potato disease in the field

Oils, Fats and Waxes Research Division

R & D Activities

Cost effective extraction of oil from Oilpalm seed, development of expelling technology and to investigate the effects of palm oil on cardiovascular system

In the recent years, the threat for attacking by high blood pressure is increasing very rapidly. No effective medicine has yet been manufactured for curing this disease completely. Palm oil is rich in tocopherols responsible for cholesterol-lowering effect. Also Bangladesh is always facing acute shortage of edible oil. In the year 2003, out of 11.0 lac ton of imported oils, palm oil was highest, 5.25 lac ton. Thus, the importance and necessity for the cultivation of Oil Palm, does need to be overemphasized.

Objectives

1. To cultivate Oilpalm tree in Bangladeshi climatic condition and to develop sustainable technology for expelling oil from palm fruit.
2. To utilize the extracted oil in producing different healthful, nutrients and delicious products

Work Progress

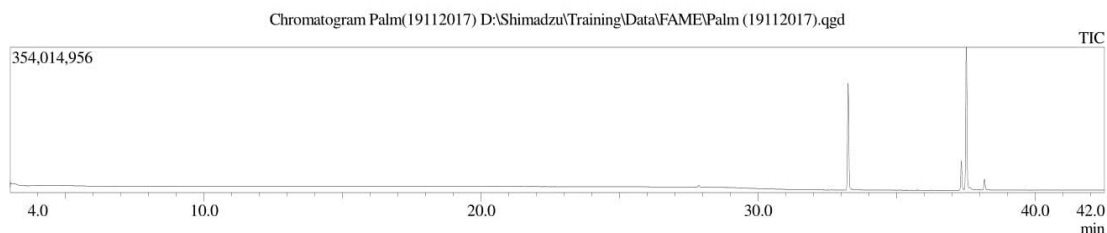
1. 305 nos. of oil palm tree has been planted in the land of BCSIR labs Rajshahi (Picture below).
2. Palm seeds from different areas in Sylhet, Nawgaon and Rajshahi has been collected, and characterizations are going on.



Data of R & D activities

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Sample Information
Analyzed by : Admin
Analyzed : 11/19/2017 10:19:02 AM
Sample Type : Unknown
Sample Name : Palm(19112017)
Sample ID : Palm(19112017)
Vial # : 15
Injection Volume : 1.00



Quantitative Result Table

ID#	Name	R.Time	m/z	Area	Conc.	Conc.Unit
1	Methyl octanoate(Caprylic acid)	8.890	127.00	25387	0.024	%
2	Methyl decanoate(Capric acid)	15.465	88.00	3261	0.003	%
3	Methyl laurate(Lauric acid)	21.934	76.00	12449	0.012	%
4	Methyl tetradecanoate(Myristic acid)	27.858	83.00	230183	0.219	%
5	Methyl palmitate(Palmitic acid)	33.242	74.00	48409777	46.094	%
6	Methyl linoleate(Linoleic acid)	37.335	67.00	17102224	16.284	%
7	cis-9-oleic acid methyl ester(Oleic acid)	37.518	87.00	30282338	28.834	%
8	Methyl octadecanoate(Stearic acid)	38.171	87.00	8991919	8.562	%

Identification and isolation of active ingredients from native medicinal plant of Bangladesh by using LCMS and Ion-trap Mass Spectrometry

A majority of the world's population in developing countries still relies on herbal medicines to meet its health needs. But still people are not fully aware about the proper uses of the plants and often misused by Kabiraj and other traditional practitioners. Therefore, it is very essential to develop highly specialized analytical tools allowing a simple, quick and accurate determination of active ingredients from the medicinal plants.

Objectives

1. To Identify and isolate the active ingredients in different medicinal plants.
2. To develop economically feasible process for the separation of unique or biological-active plant chemicals.

Work Progress

1. Nutritional, antioxidant and biological activities of Ulotkambol, Bakul and lemon leaves extracts has been investigated.

- One paper has been published; one process has been verified & under communication

Data of R & D activities

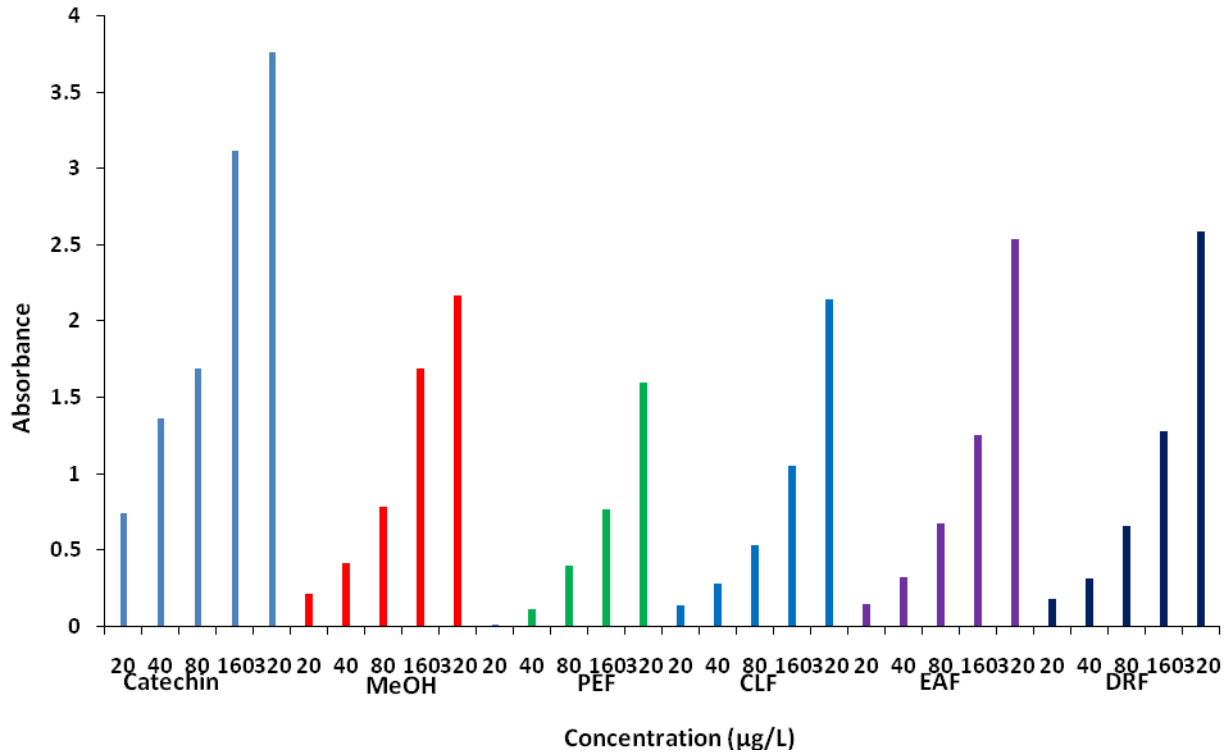


Fig.: Total antioxidant activity of different fractions of *Mimusops elengi*(Bakul) and catechin (Standard).

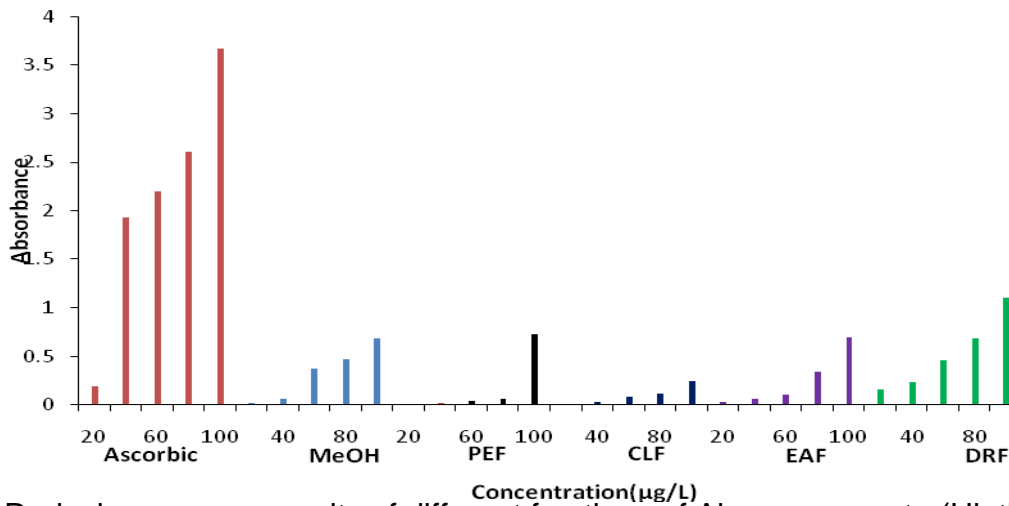


Fig.: Reducing power capacity of different fractions of *Abroma augusta* (Ulotkombol) and ascorbic acid (standard).

Sample Information

Analyzed by : Admin
Analyzed : 2/15/2018 12:47:43 PM
Sample Type : Unknown
Sample Name : Lemon Leaves Oil-4
Sample ID : Lemon Leaves Oi-4
Injection Volume : 0.20

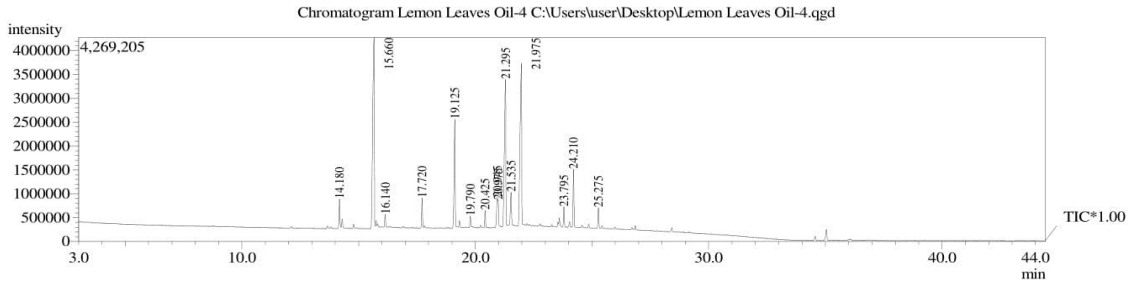


Fig.: GC-MS analysis of Lemon leaves oil.

Sustainable production of food-grade cellulose derivatives using agro residue as resource

Every year in Bangladesh, large amount of CMC is being imported to meet her demand. Effort has been made since 1980 in searching for less expensive alternatives to expensive cotton, such as various lignocellulosic biomasses that are rich in cellulose, for production of CMC. Therefore, there is growing interest worldwide in conversion of wheat straw or other crop residues into value-added products, such as CMC. Kim and Dale [2004] observed 1.3 kg of wheat straw are generated from 1 kg of wheat grains depending upon its variety and climatic conditions. Though some researchers have done some work on wheat straw, but a literature search found no published reports for producing CMC from wheat straw elsewhere in the country.

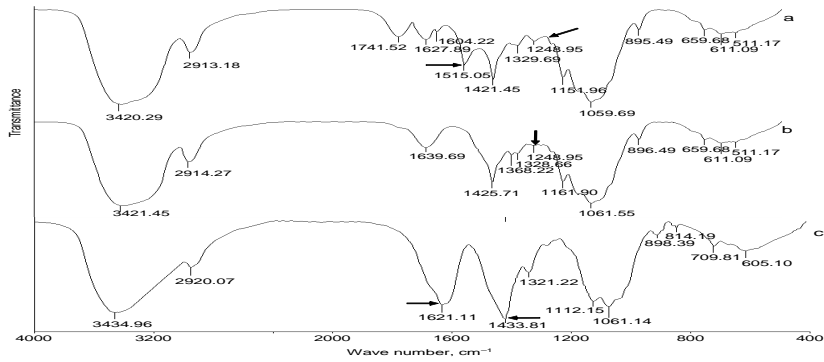
Objective

1. To prepare food grade derivatives such as CMC using cellulose extracted from wheat straw
2. To develop sustainable technology for CMC preparation

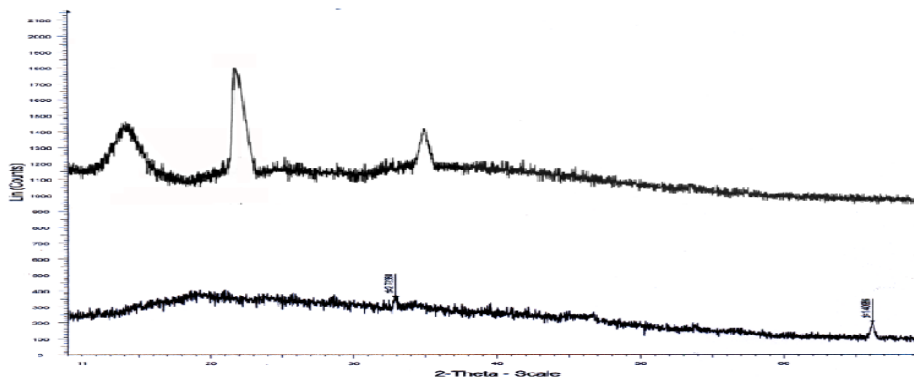
Work Progress

1. Food grade CMC with higher yield as well as high purity has been prepared
2. Two papers have been published, One book chapter under verification

Data of R & D activities



FTIR spectra of (a) wheat straw, (b) extracted cellulose, (c) prepared CMC with DS 2.5

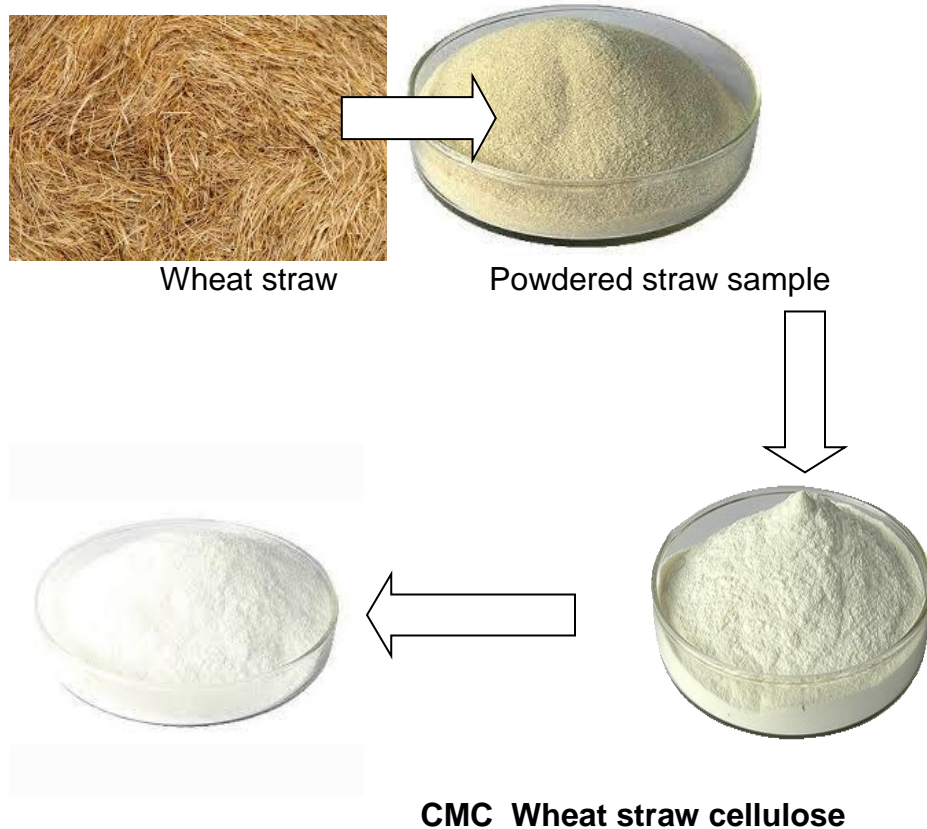


X-ray diffractogram of (a) straw cellulose and (b) carboxymethylated cellulose (DS=2.5)



SEM image of CMC at 100 magnification (100 μm size bar)

Flow diagram of CMC preparation



Research Papers

Rabbi M.A., Akhter A., Khan M., Kadri H.J., Maitra B., Khatun M.H., "Chemical composition and antifungal activity of sugarcane bagasse and banana stem based wood vinegar", International journal of Chemical, Biological and Physical Sciences, 7(4), 898-904, 2017.

Akhter A., Khatun M.H., Kadri H.J., Maitra B., Hasan M.M., Rabbi M.A., "Preparation, characterization and application of green coconut shell (Cocos nucifera) extract based azo dye", International journal of Chemical, Biological and Physical Sciences, 7(4), 974-978, 2017.

Rabbi M.A., Akhter A., Islam M.B., Khatun M.H., Kadri H.J., Maitra B., "Swelling behaviors of starch-g-polyacrylamide hydrogel: before and after saponification", International journal of polymer and textile Engineering, 4(5), 19-22, 2017.

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Md. Badrul Islam, Md. Moniruzzaman Sarker, Md. Redwanur Rahman, Mala Khan, Md. Jewel Hosen, Md. Abu Hasan, M. A. A. Shofi Uddin Sarker, Mirola Afroze, Fatty Acid Profile of Freshwater Crab (*Paratelphusa lamellifrons*) from Padma River of Rajshahi City, Bangladesh, *Journal of Nutrition & Food Sciences*, Sci 7: 641. , 2017 doi: 10.4172/2155-9600.1000641

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S. N. Jahan¹, M. A. Bayezid¹, B. Islam, M. A. B Siddique¹, P. K. Karmokar, F. A. Flowra Biochemical Quality Assessment of Fish Powder, *American Journal of Food and Nutrition*, 2017, Vol. 5, No. 3, 110-114, DOI:10.12691/ajfn-5-3-6

Sarmin Akther, Md. Badrul Islam, Habibur Rahman¹ and Abdus Salam Bhuiyan Proximate composition and nutritional value of fish powder composition (FPC) from different dried SIS fishes in Bangladesh, , *Research Journal of Food Science and Nutrition*, Volume 3. Page 9-14. Published 23rd February, 2018

M. M. Rahman, M. N. Haque, S. Hosen, J. Akhter, U.S.B. Kamal, E. N. Jahan, ASM S. Hossain, M. N. Uddin, M. B. Islam, M. R. Islam, AHM K. Alam and A. Mosaddik Comparative evaluation of antimicrobial activity of different parts of *abelmoschus moschatus* against multi-resistant pathogens, , *IJPSR*, 2017; Vol. 8(4): 1874-1880.

Nurunnahar, Md. Uzzal Haque, Ronok Zahan, Md. Badrul Islam and Ashik Mosaddik, Evaluation of Antioxidant Potentiality of Methanolic and Aqueous Extracts of *Pandanus foetidus* R. Leaves, *Journal of Complementary and Alternative Medical Research* 3(1): 1-6, 2017; Article no. JOCAMR.34109

Ismat Ara Dahlia, Md. Badrul Islam, Shahed Zaman, Md. Asadul Islam, Md. Abdul Jalil, Nazim Uddin Ahmed, Md. Abdur Rahim, Md. Mahmudul Hassan Mondol, Ali Ahsan Muzahid, Murshed Hasan Sarker In-vitro DPPH Free Radical Scavenging Activity of the Plant *Murraya koenigii* Linn (Curry Leaf) in Rajshahi, Bangladesh. *Journal of Complementary and Alternative Medical Research*, 3(4): 1-9, 2017;

Ahmed NU, Nur HP, Islam MS, Alam AKMS, Rahman MZ and Rahim MA. Among the plant seeds, oil producing seeds can be a promising source of lead compounds for the palliative treatment of non-communicable diseases: A review.

Islam MJ, Amin MR, Ahmed MF, Khatun S, Rahman ML, Siddiqui SA, Rahman MA, Kudrat-E-Zahan M and Mannan MA "In-vitro Antimicrobial Activity of Essential Oils and Different Organic Extracts of *Lippia alba*", *Journal of Phytochemistry & Biochemistry*, Vol 2(1) *Received Date: Feb 15, 2018 / Accepted Date: Feb 21, 2018 / Published Date: Feb 28, 2018.*

Md. Anamul Hoque a, Farid Ahmed, Md. a,b, Mohammad A. Halim c, Mohammad Robel Molla a, Shahed Rana a, Mohammad Azizur Rahman d, Malik Abdul Rub e Influence of salt and temperature on the interaction of bovine serum albumin with cetylpyridinium chloride: Insights from experimental and molecular dynamics simulation; *ELSEVIER : Journal of Molecular Liquids* 260(2018)121-130.

Roy N.C., Hasan M. M., Kabir A. H., Reza M. A., Talukder M. R. and Chowdhury A. N., "Atmospheric pressure gliding arc discharge plasmas for improving germination, growth and yield of wheat", *Plasma Sci. Technol.* in press Manuscript ID: PST-2018-0103.R2 (2018).

Roy N. C., Hasan M. M., Talukder M. R., Hossain M. D. and A. N. Chowdhury, "Prospective Applications of Low Frequency Glow Discharge Plasmas on Enhanced Germination, Growth and Yield of Wheat." *Plasma Chem. Plasma Process* 38,13-27,2018.

Roy N. C., Talukder M. R. and Chowdhury A. N., OH and O radicals production in atmospheric pressure *air/Ar/H₂O* gliding arc discharge plasma jet. *Plasma Sci. Technol.* 19, 125402, 2017.

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Yeasmin M.S., Jalil M.A., Uddin M.M., Akter N and Rahim M.A., Carboxymethyl cellulose synthesis from wheat straw and physiological effects as food additive on some haematological and biochemical parameters of male mice, *Journal of Chemical Biological and Physical Science*, 8(4), 820-829, 2018.

2.2 Process Accepted

Islam M. D., Jalil M. A., Shafi M. Z., and Ahmed N.U. "Production of vitamin C enriched amla candy"

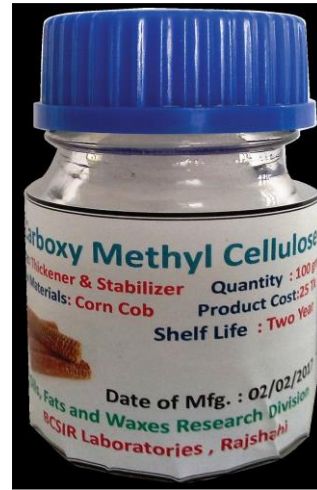
Scientists pursuing M.S/M.Phil/Ph.D. Courses in home or abroad:

1. Md. Ahasanur Rabbi, Scientific Officer, Fibre & Polymer Research Division is pursuing M.Phil (Leading to PhD) at the Department of Chemistry, University of Rajshahi under the supervision of Prof. Dr. Hasan Ahmad and working on "Preparation of polymer particles derived from natural polymer and their application as adsorbents for biomolecules and toxic metal-ions", July, 2017- June, 2021.
2. Md. Badrul Islam, Senior Scientific Officer, Drugs and Toxins Research Division BCSIR labs, Rajshahi at the Institute of Environmental Science, University of Rajshahi, under the Title "Research Title: Investigation on Seasonal Variation of Bio-Chemical Composition of Crab."
3. Most. Halima Khatun, Scientific Officer, Fibre & Polymer Research Division is pursuing PhD at the Institute of Environmental Science (IES), University of Rajshahi under the supervision of Prof. Dr. Md. Golam Mostafa and working on "Application of natural dyes on textiles and their environmental sustainability", July, 2016- June, 2019.
4. Name: Md. Zamilur Rahman, Senior scientific officer, Applied Botany Research Division, BCSIR Labs. Rajshahi, pursuing Ph.D. degree from Institute of Biological Science, University of Rajshahi Bangladesh under supervisor of Professor Dr. Md. Shahinul Islam and co-supervisor: Dr. Arfatun Nahar Chowdhury submitted a thesis entitled "In vitro culture of solanum tuberosum (L.) in bioreactor systems: growth, development and production of microtubers" May, 2018.

Sl. No.	Title of research	Research Category(P hD/M.Phil/M .S)	Name of Student	Name of academic institution	Name of Supervisors in BCSIR
1	Synthesis and Characterization of Eco-friendly Hydrogels from cellulosic materials	PhD	Md. Obaidul Haque	University of Rajshai	Dr. Mst. Sarmina Yeasmin,SSO
2	Climate change impact on water quality	PhD	Md. Feroz Serder	Institute of Environmenta l Science, University of Rajshai	Dr. Mst. Sarmina Yeasmin,SSO

	Surveillance of poultry farms and management of enterobacteria associated diseases through ethnoveterinary medicine	PhD	Md. Showkat Hossain	University of rajshahi	Principle supervisor: Dr. Arfatun Nahar Chudhury Senior Scientific Officer (SSO) Applied Botany Research Division, BCSIR, Rajshahi. Co-supervisor: Debasis talukder Principle Scientific Officer (PSO) Applied Zoology Research Division, BCSIR, Rajshahi
	Biological Activities of Benzoin Thiosemicarbazone and its complexes.	PhD	Hossain Mohammad Zakir	University of rajshahi	Principle supervisor: Md. Murshed Hasan Sarkar Scientific Officer (SO) Applied Botany Research Division, BCSIR, Rajshahi. Co-supervisor: Ruhul Amin Senior Scientific Officer (SSO) Applied Zoology Research Division, BCSIR, Rajshahi.
	Characterization and Application of Atmospheric Pressure Gliding Arc Discharge Plasma	PhD	Nepal Chandra Roy	University of Rajshahi	Dr. Arfatun Nahar Chudhury Senior Scientific Officer (SSO) Applied Botany Research Division, BCSIR, Rajshahi.

1) Products Picture:



2) Major rare instruments:



Micro

Picture of visitors



PILOT PLANT AND PROCESS DEVELOPMENT CENTRE (PP&PDC)

Before 1983 BCSIR had no facility to conduct the techno-economic feasibility study of the processes developed in its laboratories. The techno-economic feasibility study is very essential for commercialization of any industrial process. The Pilot Plant and Process Development Centre (PP & PDC) has been established in BCSIR to fulfill this important task. This centre has been functioning as a separate unit headed by a Director with two main divisions; the design and development division and the production and fabrication division, which consist of several workshops and sections. The name of the existing workshops and sections are, (1) Design section, (2) Machine shop, (3) Feasibility Studies section, (4) Pilot plant section, (5) Foundry and pattern making shop, (6) Welding and tinsmith shop, (7) Heat treatment shop, (8) Fitting shop, (9) Process Optimization section, (10) Maintenance shop.

A large number of pilot plant studies have been carried out by the PP & PDC and a good number of processes have proved successful for commercialization.

The functions of the centre are as follows:

1. To undertake process development studies as pilot plants for commercialization and optimization the processes developed in different laboratories.
1. To design and fabricate equipment and machinery for pilot plant study.
1. To render technical and advisory services to the industries.
2. To design commercial plants of the processes developed in BCSIR.
1. To render the services of techno-economic feasibility study and market survey for evaluating the projects of BCSIR.
1. To design and fabricate of laboratory equipment and spare parts which are possible within the facility of PP&PDC.

R&D Activities:

Design, Fabrication and Pilot Plant Study of a Chatal boiler for local rice mills.

In local "Chatal" boiler are used in not environmental friendly, fuel consumption is high & more space is required for that. Also serious accident happens in every year. If the project accomplishes successfully it will reduced environment pollution, fuel consumption will reduced and possibility of accident will lower. Also local people will be interested as more benefit will come from this business. After implementing this boiler in industries, environment pollution would be minimized as per our study, fuel consumption will be reduced and possibility of accident will come down to minimal as we have used all the safety measures in this designed boiler. Also local entrepreneurs will be interested in these industries more because higher benefit will come from this business due to the designed boiler.

Objectives:

- a) Design & development of a low pressure steam boiler.
- b) To reduce environmental pollution.
- c) Maintain safety regulations as laid down in the boiler act.
- d) To reduce installation, operating & maintenance cost.
- e) To reduce fuel consumption & improve efficiency of the boiler.

Work Progress: The boiler has been designed and fabricated successfully. After that, a pilot plant study has been completed successfully in Sherpur, Bogra, where the plant has been installed. The results of the pilot plant study are quite satisfactory according to the Member (Development), BCSIR, Member (S & T), BCSIR and Chief boiler inspector, who have visited the site. The completion report with all the findings of the pilot plant study has been submitted already. Pilot Plant Study has been accepted.

Working Environment Picture:

Pilot Plant Study of boiler control in local garments using developed Human Machine Interface (HMI) software.

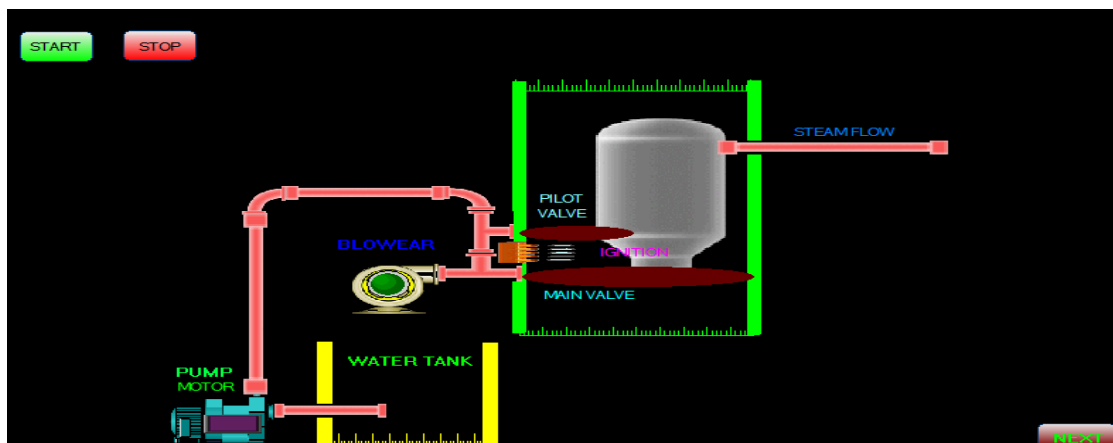
If the HMI software is developed and implemented in the country, safety factor of local boiler will be improved and accident will also be reduced. The boiler quality can be improved as international standard and consequently it can be exported to abroad. The local manufacturers use the analog device for boiler control. The safety factor and quality of boiler is less standard compared to imported boiler. If this software can be implemented in the locally produced boiler, the control system will be fully automated like foreign boiler. As a result accident shall be removed and import will be reduced.

Objectives:

1. Boiler automation for optimized use.
2. Ensuring Safety to the boiler operators
3. Affordable parameter checking for industries.
4. Auto alarm detection

Work Progress: Already this project has been completed .Completion report submitted. Pilot Plant Study Report has been accepted. Process has been submitted for evaluation.

Flow diagram and Setup picture:



Design & development of a low cost poultry feed processing machine and pilot plant study for high nutrient poultry feed production.

Poultry industry is one of the most promising industries in our country. For this industry, poultry feed is the key factor for the farmer to attain adequate profits. It costs a huge amount of money and still sometimes is not up to the marks in respect to quality. The goal of the project is to ensure poultry feed machine at low cost and this will eventually minimize the cost of the poultry feed. If this project becomes successful it would promote entrepreneurship in this industry as well. A pilot scale poultry feed machine would be manufactured. High nutrient poultry feed formula would be collected and gradually this machine will be tested for high nutrient poultry feed production. Furthermore, this machine's performance would be optimized and a feasibility study would be done. Farmers will get high nutrient poultry feed at low cost. At the same time they will own poultry feed machine at a very low investment

Objectives:

- a) Design & development of a low cost poultry feed machine.
- b) Formulate high nutrient feed and pilot scale production.
- c) Reduce importing machineries and save currency.
- d) Feasibility study of the machine/process.

Work Progress: Already related machine design and fabrication work has been completed. Laboratory trial run on-going.

Flow diagram and Setup picture:



Design, Fabrication and Pilot Plant Study of Semi- automatic Juice filling device.

If the process is developed a number of local industries will be developed in Bangladesh. As a result local people may be employed. Local entrepreneurs will also be encouraged to invest money in SME industries. PLC or microcontroller and various types of sensor will be used to operate & control the filling system. Four bottles will be filled at a time and proceed successively. This device will be used in SME. At present SME procure this type of machine from China, India, and Taiwan at higher price. The product cost will be saved at least fifty percent if this semi- automatic filling is developed.

Objectives:

- a) To develop an auto control mechanical juice filling device
- b) To design and fabricate conveyor system of plastic bottles.
- c) To develop an bottle washing device.
- d) To save foreign currency by local manufacturing technology.

Work Progress: Already related machine design and fabrication work has been completed. Laboratory trial run on-going.

Setup picture:



Process development & pilot plant study for the utilization of extracted active components from Gynura Procumbens and Stevia as food supplement.

Gynura Procumbens and Stevia are globally known as medicinal plants. In Singapore, Malaysia, and Indonesia, Gynura plant has been traditionally used as remedies for eruptive fever, rash, kidney disease, migraine, constipation, hypertension, diabetes and cancer. On the other hand, Stevia is globally used for making healthy food and known as natural low calorie sugar. This project will avail the gynura & stevia products to all over the country at a lower cost. Gynura Procumbens leaf and Stevia will be collected and their essential components would be extracted

by the processes described in literature with the solvent extraction plant. The extracted components would be categorized to define their potential usage.

Objective

- a) Feasibility study for the process development & pilot plant study for the utilization of extracted active components from *Gynura Procumbens* and *Stevia* as food supplement.
- b) To extract and separate the active components from *Gynura Procumbens* and *Stevia* in the solvent extraction plant.
- c) To develop a process for using the extracted components as food supplements.
- d) To assess the quality of the products.
- e) To evaluate eligible conditions and equipments for pilot plant study.

Work progress

1. To collect raw material cultivation of the plants are undergone with the cooperation of Tissue Culture Unit of BCSIR.
2. Selection for suitable process is going on.
3. Existing Solvent Extraction plant in the PP section of PP&PDC is being repaired for its utilization in the process.

Design and Development of a Cooling Tank for heat removal during pilot plant operation

Heat removal from many pilot plant operations become necessary to obtain proper product quality or for achieving required process conditions. In regular laboratory works often huge amount of valuable tap water is wasted for cooling, where the water is not recycled. Heat removal and saving of resources during process operation holds considerable importance. A cooling tank will be designed for connecting as a unit to operating process plants where heat removal is necessary. A circulating pump will be used to recycle cooling water. The setup will be checked changing working conditions and design data will be generated.

Objective

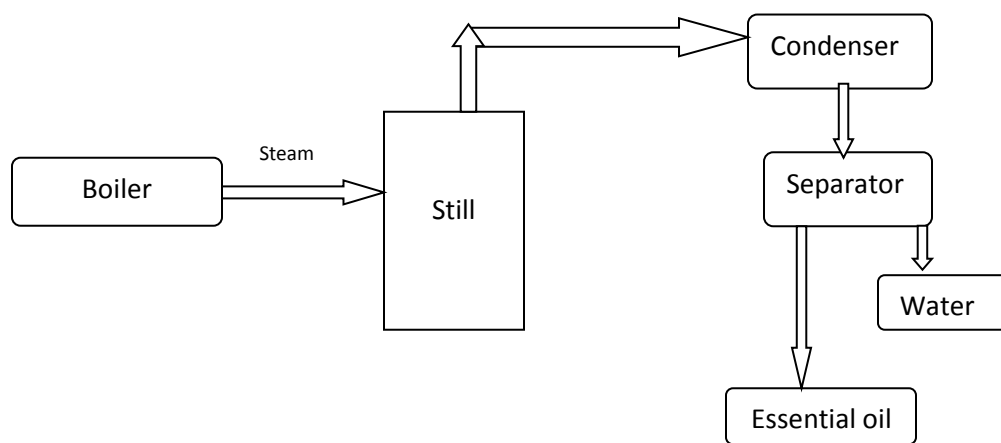
- a) To design and calculate parameters for a cooling tank to remove heat generated during pilot plant operations.
- b) To fabricate and develop the tank set up with accessories like vacuum and shower nozzles, chilling fan, circulation pump, motor, temperature, pressure and level controllers etc.
- c) To evaluate the cooling performance of the cooling tank at different conditions for pilot plant study
- d) Commercial Application of the cooling tank in the SME.

Work progress

1. Design of cooling tower has been selected
2. According to design fabrication materials and accessories will be collected
3. Fabrication/fittings will be carried out according to drawing

Design and development of steam distillation pilot plant for essential oil production from herbal plants.

Essential oils, some complex mixtures of organic compounds, extracted from plants and animals have been used to treat a variety of illnesses for thousands of years. In some cases these essential oils have therapeutic utility by modern medical standards. For example the major component of clove oil is the compound *eugenol*. Eugenol has a boiling point of 254° C. However, eugenol can be isolated relatively easily from cloves using the technique of steam distillation. Steam distillation is a technique used to distill immiscible liquids, for which steam provides one of the immiscible phases.¹The two substances mix in the gas phase and co-distill, but when cooled the desired component separates from water as it is immiscible. Steam distillation is commonly used to extract perfume and flavour oils from natural sources. *Elettaria cardamomum*, Tulsi (*Ocimum Basillicum*) etc have useful essential oil.



The flow diagram of steam distillation is as above.

Objective: A steam distillation plant is fabricated at pilot plant scale under this R&D project.

1. Very small amount of essential oil is extracted from large amount of herbs. So to have sufficient amount of oil larger plant is needed.
2. Steam distillation is more effective than hydro distillation.
3. The establishment of a steam distillation plant at pilot plant scale will ease the other research related to herbal medicine, cosmetics etc.

Work Progress: A steam distillation pilot plant was designed (30inch diameter, 2.5 feet high, water volume 350 lit) and fabricated at PP&PDC under this project. One run is given with Eucalyptus leave. 1.2% yield was found for Eucalyptus oil. The extracted essential oil is separated from water using oil water separator. Only one lack taka is expensed for the work done. SS sheet was used from store.



Steam distillation pilot plant



oil water separator for oil lighter than water

The basic work of the project is completed. The project is requested to extend for one more year. Approximately 1.5 lack taka is needed to modify the design for make the automated loading system, make it usable for both hydro (material dipped into water and direct gas heat) and steam distillation, auto water level control. More runs will be given for different natural products for cost analysis. More research work can be done from the idea of superheated steam distillation process.

Pilot Plant Study for Production of Construction Material from ETP Wastage.

Huge amount of ETP waste is dumped into the environment every year which is causing water pollution and hampering soil nutrient percentage that ultimately culminates into low fertility of those lands. The goal of this project is to check the feasibility of mixing ETP wastage with the clay for brick making. On the other hand, to assure “Zero Discharge” from industries, this assessment would help us find solutions to dislodge the amount of solid waste from industries.

Objectives:

1. To assess the generalized quality of the ETP/Solid wastages.
2. To produce construction materials (Compressed Earth Block & Bricks) from the wastages and evaluate the industrial processes for production.
3. To generalize and optimize the production methods by trial and error methods.

4. Assess the conformity of the products regarding to standards of Bangladesh Government and ensure stability of the products.

Progress:

1. Raw Clay and Industrial sludge has been tested (in XRF) for their properties.

Sludge Origin	Status/Condition
Textile Sludge 1	SiO ₂ content very low CaO content high
Textile Sludge 2	SiO ₂ content very low
Sugar Industry Sludge	SiO ₂ content low

2. For making Green Compressed Earth Blocks (CEB) 'CEB manufacturing machine' has been designed and fabrication is on-going.
3. At initial level, Burnt bricks made with 5% Sludge have conformed to standard.

Image of Initially developed CEB Machine:



Process Development of the Lithium Compounds and Valuable Substances from Lithium Ion Battery (LiB) e-Waste.

LiB is an essential part of almost every portable electrical and electronic goods and usually contains lithium, aluminum, copper, nickel/ manganese/ cobalt, iron and a certain amount of valuable materials such as graphite or activated carbon. The lack of any domestic primary sources (mines) of such elements makes their recycling important from both economic and environmental perspectives.

Objectives :

1. To identify and estimate the possible valuable substances extractable from LiB.
2. To develop a process for recovering such valuable substances from LiB.
3. To characterize the recycled products depending on physical or chemical properties.

Work Progress

1. A paper published in international Journal
2. Process for LiCO_3 and Co_3O_4 will be submitted.
3. The work is going on.

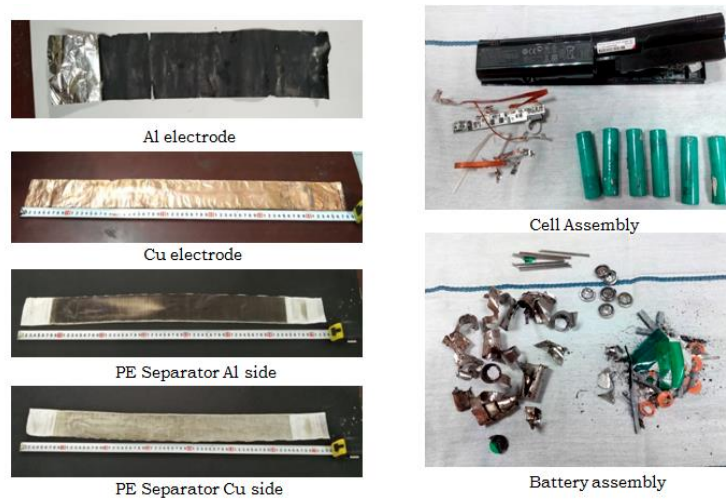


Fig: Development of the Lithium Compounds and Valuable Substances from Lithium Ion Battery (LiB) e-Waste

Pilot Plant Study for developing Tin-Zinc Alloy for Lead free solders.

The global electronic assembly community is striving for a robust replacement for leaded solders due to increased environmental regulations. Sn-Zn based solder can be a possible replacement of Pb solder because of its better mechanical properties. The Sn-Zn based alloys need to be studied to get a usable solder alloy having better properties. In this work one eutectic binary Tin-Zinc alloy and twelve ternary alloys [Sn-(9-x)Zn-xAl, Sn-(9-x)Zn-xSb and Sn-(9-x)Zn-xBi] will be prepared and their physical, mechanical, and electrical properties will be investigated.

Objectives:

1. To develop Tin-Zinc based alloy systems replacing the high lead (Pb) containing solder alloys which will be environment friendly and cost effective.
2. To characterize the mechanical, thermal and electric properties of the alloys with respect to traditional solder alloys.
3. To make a pilot plant study of the alloy development process.
4. Work is going on.

Work Progress:

1. One Invited talk "In search of Lead Free Solder Alloy" was given at Conference on Weather Forecasting & Advances, Organized by Dept. of Physics, KUET.
2. One paper "Study of the Mechanical and Thermal Properties of Sn-9Zn and Sn-8Zn-1X(Where X=Al, Bi and Sb) as Lead Free Soldering Alloy" was presented at the INCOM18, Porc. 1st International Conf. on Mechanical Engg, Dept. of Jadavpur University, Kolkata, India and published in the proceedings.

Extraction of valuable substances from of E-waste (Printed Circuit Board or PCB)

Continual changes in technology, data storing medium are responsible for the availability of wide range of e-waste like discarded desktop computers, mobile, laptops, printers, keyboard, batteries and other household electrical appliances. E-waste can be a good source of metals and alloys if proper recovery process can be established. PCB or printed circuit board which is an essential part of almost every electrical and electronic goods and components usually contains epoxy resin, fiberglass, copper, nickel, iron, aluminum and a certain amount of precious metals such as gold and silver

Objectives:

1. To develop a process for recovering various metals and valuable substances from PCB.
2. To optimize the recycling process.

Work Progress:

1. The effects of different parameters on leaching for extraction of four metals eg. Cu, Sn, Ag and Pb were established. Recently the shredder has been included in our research facilities which will enable the appropriate leaching condition for the PCBs. The project is to be extended for a year.

Pilot Plant Study for Recovery of Aluminium and Zinc from E-waste (Computer hard disk and dry cell Battery).

In 2014 Bangladesh produced 126 kilo tons of e-waste. This huge amount of waste if not recycled, serious threat on environment is inevitable. Because e-waste may contain heavy metals which are injurious to health. However, e-waste can be a good source of metals and alloys if proper recovery process can be established. For instance, in a computer hard disk, major portion of metal is aluminum. Furthermore, drycellbatteries can be a good source of zinc. In a typical AA size zinc-carbon battery, when discarded, contains 16.98% zinc in its shell. This work intended to urban mining of Al and Zn as a valuable product.

Objectives:

1. To develop a process for recovering aluminum and zinc from computer hard disks and dry cellbatteries
2. To optimize the recycling process.
3. To characterize the recycled products depending on physical and mechanical properties.

Work Progress:

1. The project work has been completed.
2. A pilot plant study on Al from Hard Disk was done.
3. Two papers on ZnO nano particle from spent Zn-C battery published in International Journal.



Fig: Working Environment picture of Pilot Plant Study for Recovery of Aluminium from E-waste



Fig: Reovery of Zinc from E Waste (Dry Cell Batteries)

Reclamation of Metals (Tin, Aluminum, Lead, Copper, etc.) from E-waste (Mobile Phone PCBs)

PCB or printed circuit board which is an essential part of almost every electrical and electronic goods and components usually contains epoxy resin, fiberglass, copper, nickel, iron, aluminum and a certain amount of precious metals such as gold and silver . Amount of metals, ceramic and plastics could be around 40%, 30% and 30%, respectively. Precious metals such as gold and palladium in waste PCBs are richer than in natural ores, which makes their recycling important from both economic and environmental perspectives.

Objectives:

1. To develop a process for recovering various metals and valuable substances from PCB.
2. To optimize the recycling process.
3. To characterize the recycled products depending on physical, chemical and mechanical properties.

Work Progress:

1. Primary works was done for Chemical reclamation of metals by leaching without using shredder.
2. Two shredders have been procured. The whole process need to be done using shredders.
3. ICP-OES procurement process is on going.



Fig: Reclamation of Metals (Sn, Al, Pb, Cu, etc.) from E-waste (Mobile Phone PCBs)

Achievements:

Research Papers

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Hosen MS, Rahman MH, Gafur MA, and Ahmed AN, Development of Thermal Properties and Surface Morphology Poly(L-lactic)/Chitosan Blend with Microcrystalline Cellulose Obtained from Natural Jute Fibe, *Int. Res. J. of Pure and Applied Chemistry*, 15(4): 1-8, 2017, Article no. IRJPAC.39549

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Dr. Ruhul Amin, Rajat Suvra Chakrovorty “A HYSYS Simulation Project for the Production of Synthetic Ethanol by Hydration of Ethylene”, International Journal of Current Trends in Engineering & Research (IJCTER) (e-ISSN 2455–1392 Volume 3 Issue 5, May 2017 pp. 79 – 85)

Process Accepted

1. Gafur M. A. , Qadir M. R., “Pilot Plant Study for the production of Hydroxylapatite by Wet Chemical Method”, accepted by the office, Member Development, BCSIR, Dhaka.

Date: 02.10.17

2. Gafur M. A. , Qadir M. R. , Ahmed A. N. , Dhar S. A., “A process for the production of hydroxyl apatite (HAP) from fish bone”, accepted by the office, Member Development, BCSIR, Dhaka.

Ref No: 39.02.0000.043.37.086.17/342 , Date: 27.11.17

3. Gafur M. A. , Qadir M. R. , Ahmed A. N. , Dhar S. A., “A process for the production of hydroxyl apatite (HAP) from fish scale”, accepted by the office, Member Development, BCSIR, Dhaka.

Ref No: 39.02.0000.043.37.086.17/342 , Date: 27.11.17

4. Gafur M. A. , Qadir M. R. , Ahmed A. N. , Dhar S. A. , Islam M. K, "Pilot Plant Study for the recovery of Aluminium from E-waste (Computer Hard Disks)", accepted by the office, Member Development, BCSIR, Dhaka. Date: 19.12.17

5. Gafur M. A. , Qadir M. R. , Ahmed A. N. , Dhar S. A. , Islam M. K, "Design and fabrication of a single roller magnetic separator", accepted by the office, Member Development, BCSIR, Dhaka. Ref No: 39.02.0000.043.37.110.17/1283, Date: 17.01.18

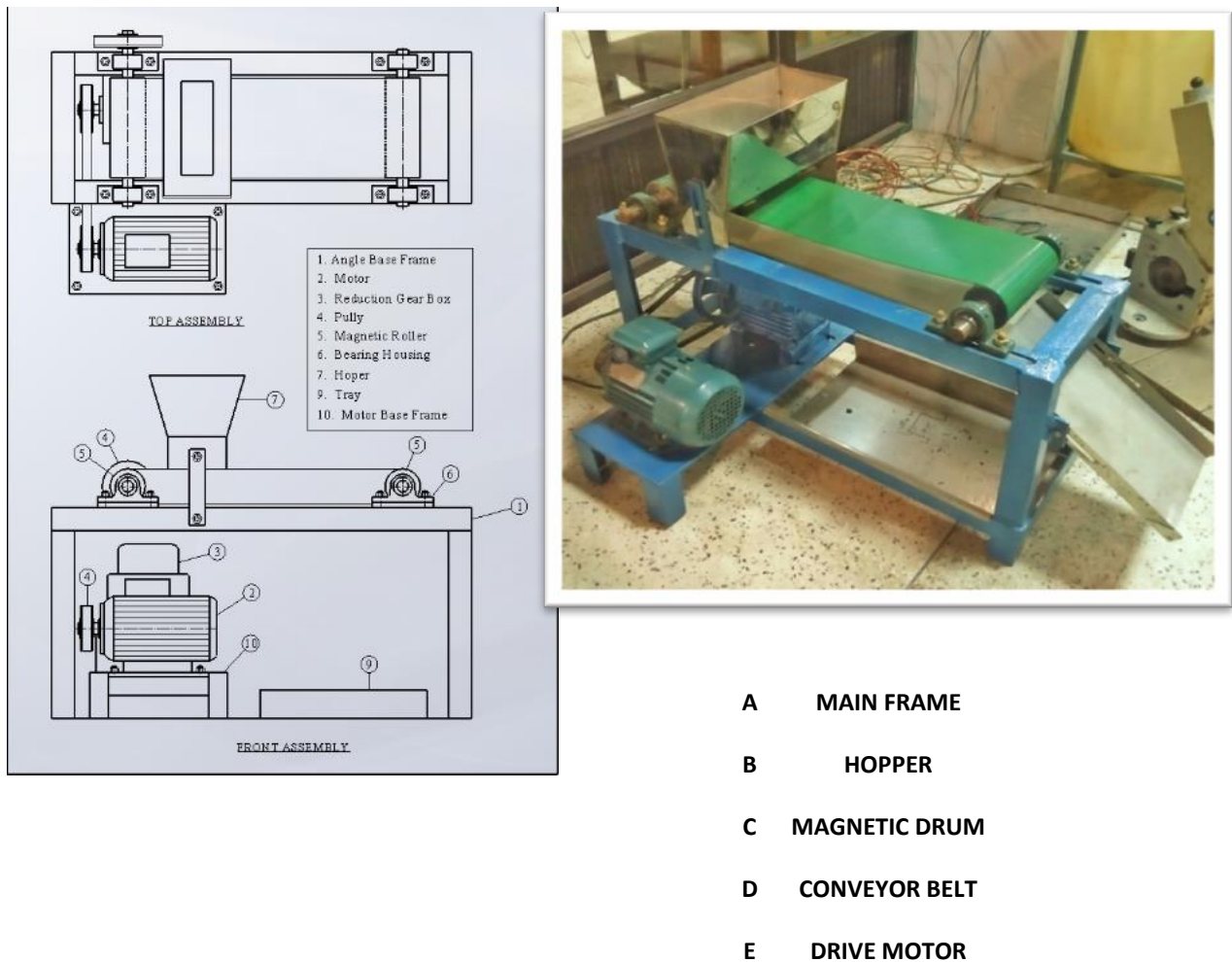


Fig: Design and fabrication of a single roller magnetic separator



Fig: Pilot Plant Study for the recovery of Aluminium from E-waste (Computer Hard Disks)

Participation in Foreign Training

Name of Trainee	Training Name	Host	Date	Country
Aninda Nafis Ahmed, Sr. Engineer	Experimental Techniques in Iron and Steelmaking	National Metallurgical Laboratory, CSIR, India	05-08 December, 2017	Jamshedpur, I ndia
SajibAninda Dhar, Engineer	Metallurgy for Engineers	National Metallurgical Laboratory, CSIR, India	12-15 December, 2017	Jamshedpur, I ndia
Md. RakibulQadir, Sr. Engineer	Metallurgical Analysis of Failure	National Metallurgical Laboratory, Csir, India	16-19 January,20 18	Jamshedpur, I ndia
Rupesh Chandra Roy Director	Pre-shipment inspection of 5 Axis CNC Machine	Maschinenfabrik Berthold Hermle AG	22-28 April 2018	Germany
Sarker Kamruzzaman PSO	Pre-shipment inspection of 5 Axis CNC Machine	Maschinenfabrik Berthold Hermle AG	22-28 April 2018	Germany
Dr. Abdul Gafur, PSO	Nano Technology Training Course	Indian Institute Of Engineering Science And Technology	18 June-8 July	SHIBPUR, INDIA

Md. Arifur Rahman Khan, Engineer	Nano Technology training Course	Indian Institute Of Engineering Science And Technology	18 June-8 July	SHIBPUR, INDIA
Md. Rabiul Alam Sr. Engineer	CNC Control simulator, 3D Design software and related training for CNC Machine.	Paradyne Technologies	12 June to 8 July, 2017	KOLKATA, INDIA

Scientists pursuing MS/Mphil/PhD Courses in home and abroad:

1. Md. Rakibul Qadir, Sr. Engineer, PP & PDC, completed MSc Degree from the Department of Materials and Metallurgical Engineering, BUET, result published on Feb, 2018
2. Rajat Suvra Chakrovorty, Engineer, PP & PDC pursuing MSc Degree from the Department of Chemical Engineering, BUET, under supervision of Associate Professor Dr. Shoeb Ahmed.

3. Academic Research Guidance/Supervision:

Sl. No.	Title of the Research	Research student Category	Name of the Institution	Name of the Supervisor in BCSIR
1	Effect of Fiber-surface Modification onto Material Properties of Sponge gurd Fiber Reinforced Polylactic Acid Bio-Composites, March 2018	PhD	Taimur-AI-Mubarak	Dept. of Physics, BUET, Dhaka
2	Preparation of Ceramic Nanoparticle (Fe ₂ O ₃ , TiO ₂ , Engg and NiFe ₂ O ₄) Dispersed Polymer Matrix Composites: Comparison of Physico-Chemical Characteristics, March 2018	MSc	Md Tayebur Rahman	Dept of MSE, RU, Dr. M A Gafur Rajshahi
3	Fabrication and Characterization of α -Fe ₂ O ₃ and NiFe ₂ O ₄ Nanoparticles	MSc	Md.AbdusSabur	Dept of MSE, RU, Dr. M A Gafur Rajshahi

	Dispersed Epoxy Matrix Nanocomposites, March 2018			
4	Effects of repeated bonding on MS shear bond strength of orthodontic brackets with a composites resin adhesive- an vitro study, 2017	Dr. Mohammad Muktadir Hossain	Dept. of Orthodontic, Faculty of Dentistry, BSMMU , Dhaka	of Dr. M A Gafur
5	Preparation and Characterization of Poly(L-lactic acid) and Olig(D-lactic acid) Grafted Cellulose Composite, November 2017	Md. Masud Rana	Dept. of ACCE, IUK, Kustia	Dr. M A Gafur
6	Preparation and Characterization of Poly(L-lactic acid) / Grafted Cellulose Green Composite, November 2017	Md. Saddam Hossain	Dept. of ACCE, IUK, Kustia	Dr. M A Gafur
7	Evaluation of Enamel Surface Roughness after Bracket Debonding and Adhesive Resin Removed by S/S and WC Bur: An Vitro Study	Dr. Geeta Pyakurel	Dept. of Orthodontic, Faculty of Dentistry, BSMMU , Dhaka	of Dr. M A Gafur
8	Evaluation of Flexural Strength of polyamide nylon denture base and heat polymerized denture base materials	Dr. Mahmuda Khatu	Dept. of Prosthodontics, Faculty of Dentistry, BSMMU , Dhaka	of
9	Preparation and Characterization of ZnO nanoparticles from ZnCl ₂ and Spent Zn-C Battery Sources by Sol-gel Method, September 2017	Mithun Rani Nath	Dept. of ACCE, NSTU, Noakhali	Dr. M A Gafur
10	Influence of Yttrium (Y) doping in LaCoO ₃ on Electrical Properties	Md. Abu Taher Chowdhury	Dept. of Physics, SUST, Sylhet	Dr. M A Gafur
11	Preparation and Characterization of Cupric Oxide Thin Film by Sol-gel Spin and Dip Coating Technique	Dipika Rani Bhowmik	Dept. of ACCE, NSTU, Noakhali	Dr. M A Gafur
12	Extraction of Precious Metals	BSc Md. Riyadh Electron	Department of Chemical	Dr. MA Gafur

	From E-Waste (Brand Mobile Phone PCB), May 2018	Engg	Engineering & Polymer Science
13	Extraction of Aluminum from Computer Hard Disk, 2018	MSc Swadip Das	Dept. of ACCE, NSTU, Noakhali
14	Extraction of Precious Metals from E-waste (Brand Mobile PCB)	MSc Tasnuba Zannat Mumu	Dept. of ACCE, Dr. MA Gafur NSTU, Noakhali NSTU
15	Extraction of Precious Metals from E- Waste (Non-Brand Mobile Phone PCB)	MSc Pallab Chakraborty	Dept. of ACCE, Dr. MA Gafur NSTU, Noakhali
16	Selective leaching of Precious Metals from E-waste (Non- Brand Mobile PCB), October 2017	MSc Halima Khatun	Dept. of ACCE, Dr. MA Gafur NSTU, Noakhali
17	Extraction of Precious Metals from E-waste (Computer M/B)	MSc MD. KAMRUG GAMAN	Dept. of ACCE, Dr. MA Gafur NSTU, Noakhali
18	Extraction Of Precious Metals From E-Waste (Non-Brand Mobile Phone PCB)	BSc Engg Afia Anjum Mim	Department of Dr. MA Gafur Chemical Engineering & Polymer Science
19	Extraction of Precious metals from E-waste (mobile printed circuit board)	MSc Md Ashikin Dewan (Shovon)	Dept. of ACCE, Dr. MA Gafur NSTU, Noakhali
20	Synthesis of (1-x) [Bi _{0.9} Eu _{0.1} FeO ₃] + x [Ni _{0.6} Zn _{0.4} Fe ₂ O ₄] Nanostructured Multiferroic Composites and Study of its Structural, Magnetic and Electrical Properties	MSc Al Masud	Dept. of Physics Dr. MA Gafur

Institute of Fuel Research and Development (IFRD), BCSIR



Institute of Fuel Research and Development (IFRD) Building

Institute of Fuel Research and Development (IFRD) launched its journey as the Fuel Research Division of the East Regional Laboratories of PCSIR in Dhaka in 1955. In 1967, it was renamed as Fuel and Petrochemical Science & Technology Division of East Regional Laboratories. After the independence, it was renamed as Fuel Division of BCSIR Laboratories, Dhaka. In 1980, the Institute of Fuel Research and Development was established as a separate institute of BCSIR with two Divisions named Research division and Application division.

Remarkable Functions of IFRD:

- ❖ Conducting applied research and development (R&D) on solar energy, biogas, biomass, bio-fuel (bio-diesel and bio-ethanol), wind energy and all other renewable energy resources including reuse of waste material for the production of energy.
- ❖ Qualitative development of different traditional fossil fuels and conduct research and development on cost effective consumption of electricity and fuel.

- ❖ Analytical Service is provided for testing of qualitative value of fossil fuel as well as different kinds of renewable energy resources and related products such as Solar cell, Solar panel, Battery etc.
- ❖ Consultancy Service is provided to all Government and Non-Government organizations about Improved Cook Stove (ICS), Biogas, Solar energy and all kinds of fuel energy.
- ❖ Different products and technologies innovated by Institute of Fuel Research and Development are disseminated to various level of entrepreneurs by intensive training program on Improved Cooked Stove (ICS), Biogas and Solar energy technology etc.
- ❖ Supervision of Graduate and Post Graduate (Masters, M.Phil., Ph.D.) thesis related to power and energy.

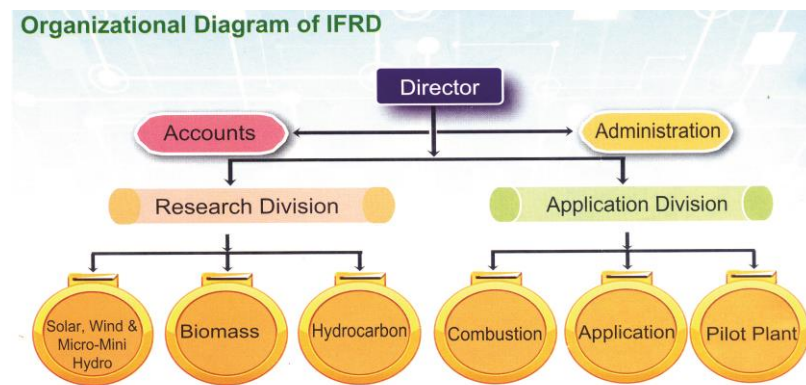


Fig: Organizational Diagram of IFRD

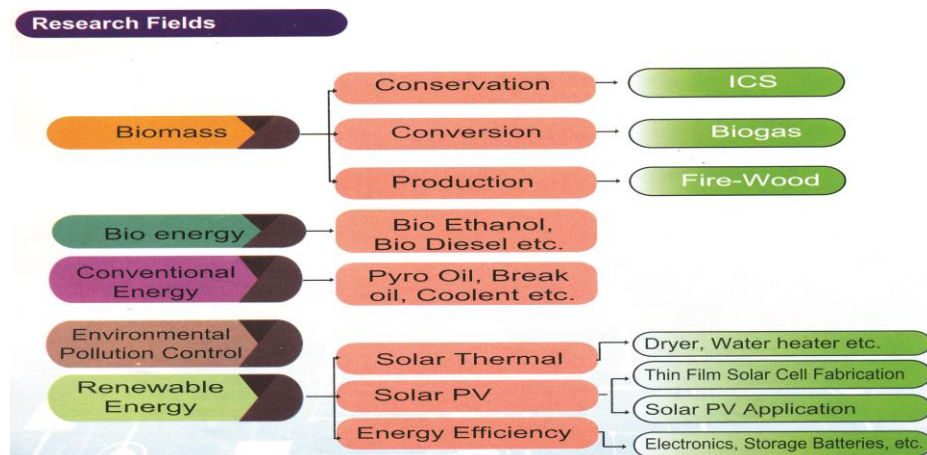


Fig: Research of IFRD

R&D Activities:

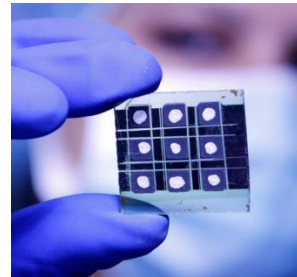
Fabrication and characterization of thin film solar cell for low cost solar power

Objective:

- To develop the concepts, materials, and processes necessary to produce environment friendly thin-film solar cells economically.
- Use of earth-abundant material.
- Optimization and characterization of different layer of thin film solar cell.

Achievement:

CdTe and CZTS full solar cells were made using low cost method. Good efficiency of CdTe solar cell was obtained and further research for improving the property of different solar cell layers is in progress. CZTS solar cell was made by low cost sol-gel method (like spin coating, Chemical Bath Deposition) and optimization of solar cell performance for different buffer layer and window layer is ongoing. Four journal-papers were published and three MS thesis students were supervised.



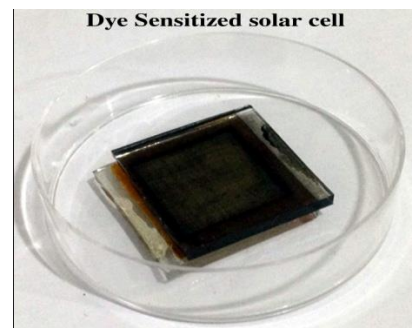
Fabrication and characterization of dye Sensitized Solar Cell.

Objective:

- Photovoltaic energy production even in low-light conditions such as non-direct sunlight and diffused sunlight.
- To manufacture Dye Sensitized Solar Cell with traditional roll-printing techniques and local low cost raw materials.
- To use natural dyes which are abundant in nature and improve cell performance
- Optimize different fabrication conditions and parameters to improve the DSSC performance.

Achievement:

Dye Sensitized solar cells were made using Eosin, Spinach, grapes, pomegranate and beet. Grinding time, solvent and deposition method of Titanium dioxide was optimized. Different dye extraction



methods were also used. Research and optimization on dye Sensitized Solar Cell performance with different counter electrode is continuing.

Continuous monitoring and collection of solar insolation data at different altitude and latitude among different locations of Bangladesh.

Objective:

Continuous solar radiation data for the year round is needed to design solar home system or any kind of solar related analysis. On the other hand, in Bangladesh there has no available list of solar radiation data. Besides, to draw any bottom line for solar radiation it needs at least ten years' data. This project will analyse the solar insolation at different location with different latitude and altitude so that it will design a solar energy map of Bangladesh. This map will show the suitable place for implementation of any kind of solar energy system.

Achievement:

For solar energy research time-based solar radiation data like Global radiation, direct radiation, diffused radiation, active sun hour, far-infrared radiation and temperature etc. has been being collected from the rooftop of IFRD building. This would be the main database for the solar energy research.



Design and optimization of solar thermal devices using different collectors.

Objective:

- To design and develop of different types of solar thermal devices (heat energy storage, indoor cooker, water heater, air cooler, dryer, water distiller etc.).
- To utilize available solar heat energy.
- To reduce the use of fossil fuel for energy consumption.

Progress/ achievement:

Parabolic trough collector has been developed and investigated the outlet water temperature with solar radiation using three different types of reflectors: aluminum foil,



aluminum sheet and mirror film. It is found that mirror film has highest durability and can provide higher outlet water temperature compared to other reflectors. The average efficiency was found as 48% for mirror film reflector. So, this low cost parabolic trough water heating system can provide to be beneficial for industrial heating applications as well as domestic heating. Using this same structure, cooking and solar distillation also can possible and recent work is following that.

Enhancing usable appliances and optimization with solar photovoltaic integration

Objective:

- To design and implementation of different types of solar powered devices (Solar hat, solar charging bag, solar cooking system etc.).
- To utilize solar energy in regular use.
- To make some user friendly and fancy appliances.

Progress /achievement:

Solar charging backpack and solar farming hat using solar pv have been developed. Beside this, solar umbrella and grass cutter is almost done to utilize it as required solar powered appliances. The work for other appliances (portable solar generator, solar cooking) is running. Two patents and one process have been submitted. One paper is ready to submission.

Production and characterization of bio-diesel from waste material in Bangladesh

Objective: To produce bio-diesel, an alternative to fossil fuel.



Progress: The aim of this project is to find out the alternative of fossil fuel to minimize the fuel crisis that is increasing day by day in Bangladesh. Biodiesel production

technology has been developed successfully by using different non-edible oil sources as raw materials such as *Jatropha Curcus*, *Ricinus Communis*, eucalyptus oil etc. and waste material.

Achievement: One paper was published. One Scientist doing PhD on a topic related to this project.

Evaluation & study on social, environmental & economical impact on the installed Biogas plant under Biogas pilot plant project of BCSIR.

Objective: IFRD, BCSIR have been installed more than twenty four thousands Biogas plant all over the country under different projects of BCSIR. More than one lac people are directly getting benefits from these plants. So it has a great social, environmental & economical Impact. Under this R&D project, related scientists are trying to figure out these impacts.



Progress: 35 districts were evaluated.

Production of Ethanol from bagasse

Objective:

- To produce bio-ethanol that will be replacement of petrol and gasoline.
- To proper utilize the locally available bagasse that are produce from sugar mill.
- To solve disposal and environmental pollution problem

Progress: Pretreatment is an important steps for the production of bio-ethanol from lignocelluloses biomass. Ball milling pretreatment have been done and optimization of substrate concentration, milling time and enzyme loadings have been finished. 10% substrate concentration, 1 hour milling time gave the best response for enzymatic saccharification. Yield of enzymatic saccharification is increased with increasing enzyme loading. Fermentation of hydrolysis also finished.

Achievement: One journal paper has been submitted. One PhD student worked on this project in this year.

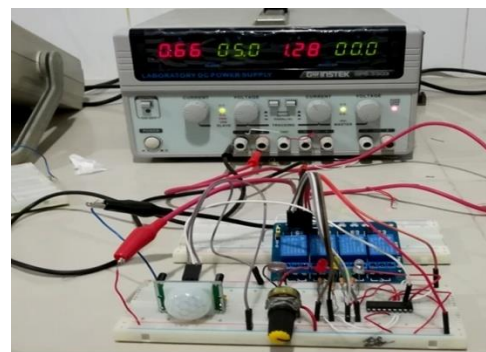
To conduct a research for an Energy Efficient Lighting System and development of technology to reduce power consumption of home appliances.

Objective:

- To develop an energy efficient home/office lighting system.
- To develop a technology that can reduce power consumption of our common home appliances.
- All the system and circuit will be made with locally available materials and components.
- Making cost will be much lower than the imported one to help SME.

Progress:

- Literature survey and design of the control circuit of the intelligent lighting system is completed.
- Development of the program and writing it to the microcontroller chip done.
- Demonstration in the laboratory scale is going on.



Development of Low Cost Auto Sun Tracker with Locally Available Components.

Objective :

- To develop an Auto Sun Tracker to harvest more solar insolation
- To ensure the manufacture of Sun Tracker with locally available materials and components
- To minimize the production cost of Sun Tracker compare to the imported one

Progress achieved:

- Literature survey, preparation of the action plan and design of the circuit of Auto sun tracker system is completed.
- Development of the circuit & total system and finalization of the proposed model are almost done.
- Demonstration in the laboratory and roof of the IFRD is going on.



Investigation on the use of maize waste for the production of biogas.

Objective :

- To produce biogas from maize waste
- Characterization of the substrate
- To determine optimum conditions for biogas generation from the substrate
- To study the economic feasibility of the technology

Progress achieved:

- Raw material has been characterized
- Two B.Sc thesis has been supervised
- One paper ready for submission

Anaerobic design of waterhyacinth by mixing with other substrate

Objective:

- To produce biogas from water hyacinth.
- Characterization of the substrate
- To determine optimum conditions for biogas generation from the substrate
- To study the economic feasibility of the technology

Progress/ Achievement:

- Raw material has been characterized.
- Biogas has been produced at different condition.
- Optimization of the process has been completed.
- 50% work has been completed.

Production and characterization of Charcoal and Activated carbon from jute stick

Objective :

- Characterization of raw material.
- Production of charcoal
- To optimize the production process of charcoal
- Characterization of produced charcoal
- Production of active carbon from produced charcoal
- Characterization of activated carbon

Progress achieved:

- Raw material has been characterized.
- Charcoal has been produced and characterized.

- Activated carbon has been produced using chemical activation process at different temperature.
- Activation capacity has been determined.
- 50% work has been completed.

Development of technology for production of lube oil from heavy condensate of different gas fields

Objectives

- To study the characteristics of condensate.
- To develop a process for lube oil production from gas field's condensate..
- Foreign currency saves.

Progress achieved: Literature survey has been completed.

Production of Bio-lubricating oil from non-edible seeds.

Objectives:

- To develop a process for bio-Lubricant production from non-edible seed oil
- To study the characteristics of produced bio-lubricating oil.
- Creation of employment opportunity,
- Reduction of import cost of lubricating oil, poverty alleviation etc.
- Reduce Green house gas emission

Progress achievement:

Caster seed has been collected and oil extracted by solvent extraction method. Characterization of oil has been done. Research on Bio-lubricating oil is in Progress. One Journal Paper was published and one M.S. thesis student worked on it.

Castor Plant And Castor Seed



Achievements:

Research Papers

Saadman Sakib Rahman, Md. Zurais Ibne Ashraf, M.S. Bashar, M. Kamruzzaman, A.K.M. Nurul Amin, M.M. Hossain, "Cristallinity, surface morphology and chemical composition of the recast layer and rutile-TiO₂ formation on Ti-6Al-4V ELI by wire-EDM to enhance biocompatibility.", The International Journal of Advanced Manufacturing Technology, December 2017, Volume 93, Issue 9–12, pp 3285–3296

M. Khalid Hossain , M.F. Pervez , M. Jalal Uddin , S. Tayyaba , M.N.H. Mia , M.S. Bashar , M.K.H. Jewel , M.A.S. Haque , M.A. Hakim , Mubarak A. Khan, "Influence of natural dye adsorption on the structural, morphological and optical properties of TiO₂ based photo anode of dye-sensitized solar cell", Materials Science-Poland, 36(1), 2018, pp. 93-10

S. Akhanda, R. Matin, M. S. Bashar, M. Sultana, A. Kowsar, M. Rahaman and Z. H. Mahmood, "Effect of annealing atmosphere on structural and optical properties of CZTS thin films prepared by spin-coating", Bangladesh J. Sci. Ind. Res. 53(1), 13-20, 2018

M.A. Wadud, M.A. Gafur, M.R. Qadir, M.O. Rahman, "Study of the mechanical and themal properties of SN-9ZN and SN-8ZN-1X alloys (Where X=AL, BI and SB) as lead free soldering alloy.", INCOM18-124, January 2018.

T. Kamal, S. Parvez, K. M. Khabir, R. Matin, T. Hossain, H. Sarwar, M. S. Bashar, M. J.Rashid' "Chemical Bath Deposition of CdS layer for Thin Film Solar Cell", South Asian Journal of Research in Engineering Science and Technology (SAJREST) volume: 01 issue: 02

Rummana Matin, M. S. Bashar*, Munira Sultana, Aninda Nafis Ahmed and A. Gafur, "Annealing Effects on the Structural, Optical and Electrical Propertiesof Chemically Deposited CdS Thin Films using NH₄Cl ComplexingAgent",International Journal of Nanoelectronics and Materials, Volume 11, No. 2, Apr 2018

Participation in Foreign Training:

Afrina Sharmin, Scientific Officer, IFRD participated in “Nano Technology Training course” from 18 June 2018 to 08 July 2018 at Howrah, West Bengal, India

Scientists pursuing M.S/M.Phil/ Ph.D. Courses in home or abroad:

1. S.M. Asaduzzaman Sujon, Senior Scientific Officer, IFRD pursuing Ph.D. degree from Department of Environmental Sciences Jahangirnagar University, Bangladesh under supervision of Prof. Dr. A.N.M. Fakruddin and working on thesis entitled “Production and Characterization of Environment Friendly Green Fuel (Bio ethanol) from Lignocellulosic Biomass to minimize Green House Gas Emission” July, 2013 – till date
2. MashudurRahaman, Senior Scientific Officer pursuing PhD degree from the Department of Physics, Jahangirnagar University, Bangladesh under the supervision of Prof. Dr. Farid Ahmed and working on a thesis entitled "Fabrication and characterization of nanostructured thin film Photovoltaic Cells." July, 2013 – till date
3. Muhammad Shahriar Bashar, Senior Scientific Officer pursuing PhD degree from the Department of Physics, Jahangirnagar University, Bangladesh under the supervision of Prof. Dr. Farid Ahmed and working on a thesis entitled "Synthesis and Characterization of Nanostructured Composite Materials for High-Efficiency Thin Film Solar Cells." July, 2013 – till date
4. Mosharof Hossain, Senior Scientific Officer, IFRD pursuing Ph.D. degree from Department of Environmental Science, University of Jahangirnagar Bangladesh under supervision of Professor Dr. A.N.M. Fakruddin and working on “Production, characterization and upgradation of bio-diesel from waste material in Bangladesh”, July,2013 – till date
5. Afrina Sharmin, Scientific Officer, IFRD, pursuing Ph.D. degree in the Department of Electrical and Electronics Engineering, University of Dhaka, Bangladesh under supervision of Professor Dr. Zahid Hasan Mahmood, and working on a thesis entitled “Optical and Morphological Characterization of Copper Zinc Tin Sulfide Nano-crystal thin film Solar Cell”, Nov, 2014 – till date

Academic Research Guidance/Supervision:

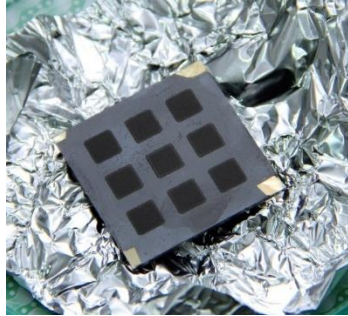
Sl. No	Title of research	Research Category (PhD/M.P hill /M.S)	Name of Student	Name of academic Institution	Name of Supervisors in BCSIR
1	A study on plasmonic silver and aluminium metal nanoparticles for enhancing light absorption	MS	Mrs. Sakina Sarwar Sattar	DU	Muhammad Shahriar Bashar
2	Study of optical and electrical properties of CZTS thin film by dip-coating precursors	MS	Mrs. Sabiha Dilruba	DU	Muhammad Shahriar Bashar
3	Optical and Electrical characterization of CZTS absorber layers prepared by solgel spin coating	MS	Mrs. Tabassum Parvin	DU	Muhammad Shahriar Bashar
4	Simulation and Modeling of Multi-junction Solar Cell with Novel Concentration	MS	Jenea Sultana	Dept. of Physics, Khulna University	Mashudur Rahaman
5	High performance solar cells based on graphene	MS	Md. Jurais Ibne Ashraf, Sadman Sakib Rahman	Ahsanullah University	Muhammad Shahriar Bashar
6	Microbial Fuel Cell: Generation of Bio-electricity, A Renewable and Green Approach by the Utilization of Bio-waste"	M.S	Md. Al Amin	Jessore University of Science and Technology	Mosharof Hossain , S.M. Asaduzzaman Sujana
7	Production and Characterization of Biofuel from rice bran oil.	M.S	Md. Naim Islam	Jessore University of Science and Technology	Mosharof Hossain , S.M. Asaduzzaman Sujana
8	Study the pellet properties made from agricultural residue by applying different pressure.	M.S.	Abdullah Al Mamun	Jessore University of Science and Technology	Mosharof Hossain , S.M. Asaduzzaman Sujana

PHOTO GALLERY



Pictures: Scientists are working in Lab

Some products' photos of IFRD:



Second generation thin film solar cell has been fabricated for the first time in Bangladesh.



Design and development of solar farm hat.



Design and development of Solar Back-pack



Achievement of ground breaking high efficiency improved cook stove (portable) with highest efficiency of 42.4%.



Indoor solar cooking has been designed and developed



Biogas Plant



Fiberglass Biogas Plant



Improved Cook Stove



Brake Oil

Institution of Food Science and Technology (IFST)

The Institute of Food Science and Technology (IFST) started functioning as an institute of BCSIR from July 1983. The institute is the largest National R&D organization which conducts research and development works in the field of food science and technology. It also renders consultancy services and technical support to the local industrialist. The outcome of research work is disseminated by means of seminars, lectures, publication and leasing out technologies. It also provides analytical service.

R&D Activities:

Development of nutritionally improved mushroom fortified atta

Introduction: Atta is widely consumed throughout the country. But, locally available attas are not up to the mark in nutritional quality. Mushroom is an excellent source of proteins with all the essential amino acids, vitamins (especially vit B₁₂ that is absent in vegetables), minerals and antioxidants. So, Mushroom fortified atta may support to meet day to day nutritional requirements.

Objectives

To develop highly nutritious mushroom fortified atta

Work Progress:

A Mushroom fortified atta is developed. Chemical analysis, functional properties, comparison with locally available atta, antioxidant analysis and sensory analysis are done. Shelf life study has been done. A paper is in writing stage

Development of value added products from buckwheat (ডেমশী) (*Fagopyrum esculentum*)

Introduction: Buckwheat (ডেমশী) (*Fagopyrum esculentum*) is highly nutritious pseudocereal known as a dietary source of protein with favourable amino acid compositions and vitamins, dietary fibre, essential minerals and trace elements, antioxidant activity. Thus, development of value added products from buckwheat may support to meet day to day nutritional requirements.

Objectives:

To develop protein, fibre, vitamins, minerals and antioxidant enriched various products.

Progress Achieved:

Two products (Buckwheat bread, Buckwheat noodles) have developed. Nutritional analysis and comparison with other locally available similar products and antioxidant analysis has been done. Shelf life study is going on. One paper is submitted

Isolation of vibriolytic phages and efficiency of phages as a therapeutic agent against cholera

Lytic phages are viruses that kill bacteria and use their synthetic machinery for morphogenesis. Phage therapy for cholera has not been established yet but it holds a great promise for treating cholera. In this study, we will monitor the effect of vibriolytic phage on the growth of *V. cholerae* and try to develop phage therapy for cholera by isolating potential vibriolytic phage from natural environment.

Objectives: The main aim of this research is to isolate an effective vibriolytic phage that can be used as an alternative of chemotherapy.

Work Progress: 2 potential phages are isolated. Sequencing of isolated phages is going on. Efficiency of isolated phages will be performed by animal model study in the next following year.

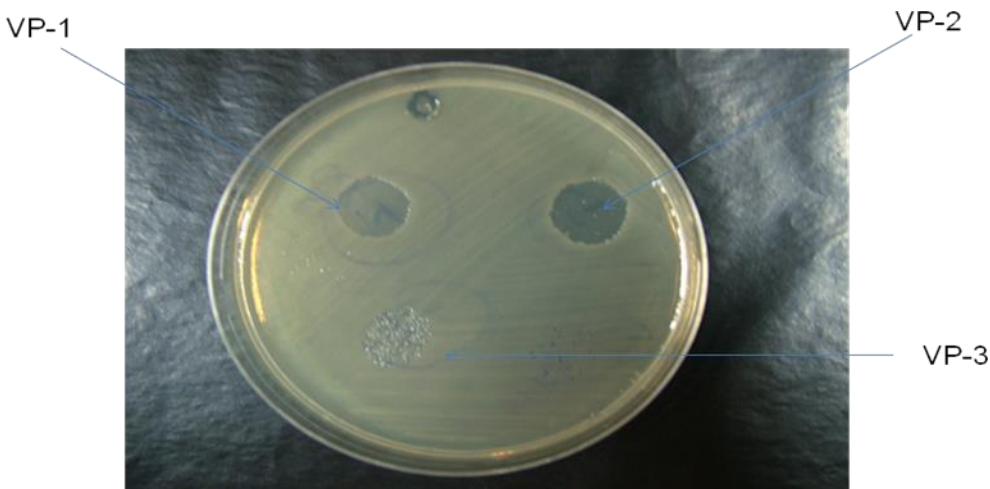


Fig: Isolated Vibriolytic Phages and their dm of clear zone

Achievements: 2 phages were isolated which has efficiency to infect *V. cholerae* One paper has been published.

Isolation, Characterization and applications of Bioactive peptides from Plant sources (such as moringa , banana, fig etc..)

Introduction: Plant is the alternative source of protein and have a significant impact on diet and nutrition. *Moringa Oleifera* also known as the 'Drumstick Tree' is recognized as a vibrant and affordable source of phyto-chemicals such as phenolic acids ,flavonoids ,alkaloids, phytosterols , natural, sugars, proteins, vitamins, minerals and organic acids. These effects have a number of possible implications for human nutrition, such as supporting role of high protein diets in the

management of Diabetes or being a source of criticism for the application of the glycemic index to mixed food.

Objectives:

Isolation of protein from *Moringa Oleifera* leaf. Studies the property of isolated protein. Binding studies of protein-carbohydrate in the diets. Measurement of glycemic index (GI) of protein rich diets. Formulation of low GI diets for diabetic patients.

Work Progress: Literature survey is going to get information about the active proteins. At the same time, the effect of single protein on pure carbohydrate is under investigation.

Investigation of Disinfection By Products (DBPs) in treated water used for food processing in aspect of food safety.

The study was concentrated on understanding the consequences and risk assessment of the disinfection by-products (DBPs) especially THMs when treated water is used in house hold work and industrial purpose. Analytical methods was developed for DBPs in water, foods and beverages. Laboratory experiments will be conducted to determine how selected DBPs, especially those produced during treatment, are absorbed by food during the cooking process. The relation between DBPs concentration in food and beverages following cooking using contaminated water will be modeled.

Objectives: To investigate the content of DBPs specially THMs in treated water. To identify the level of DBPs especially THMs in industrial and household food & beverage product processed with contaminated water. To assess the risk of DBPs.

Work Progress: Water samples from 5 different area of Dhaka city have been collected and analyzed to determine pH, TOC, TIC, TC, Cl⁻, Free Cl, THM, DBPs etc.

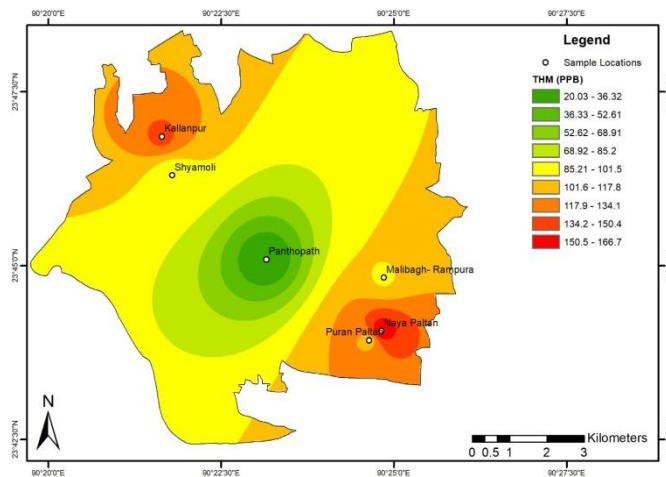


Fig: Spatial distribution of THM concentration in selected regions.

In this study, THM was measured in six distinct regions viz Puran Paltan, Naya Paltan, Kallanpur, Shyamoli, Malibagh-Rampura and Panthopath regions. Highest THM concentration was found in Kallanpur regions (139.2 ± 5.37) followed by Malibagh-Rampura area was 99.2 ± 8.39 ppb. But in Panthopath regions, THM concentration was found only 20.2 ± 8.40 ppb. In this study, THM concentration varies to regional scale.

Explore the effect on the oxidative stability and antioxidant activity of processed meat products during processing by using extracts from selected plants.

Garlic, Ginger, Onion has been used throughout their history for both culinary and medicinal purposes. They are particularly rich source of organosulfur compounds, partly responsible for health beneficial effects. Bioactive components of these spices are well known to possess antioxidant. During harvesting period, spices bulb yields a considerable amount of husk, stem and leaf which is simply thrown or disposed causing a severe problem in the community. Spices stem and leaf contains allicin, the major bioactive component which is comparatively lower than spices bulb.

Objectives:

The main aim of this research is to isolate an effective vibriolytic phage that can be used as an alternative of chemotherapy.

Work Progress:

A process has been developed to prepare raw burger patties with Antioxidant rich extract. Control and Experimental products were stored in different boxes at 4°C for self life study.

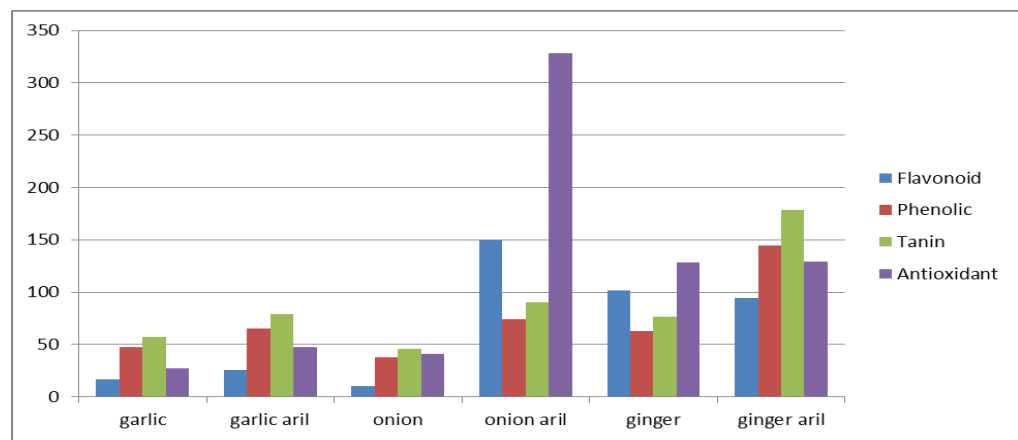


Fig: Graphical representation of flavonoid, phenolic , tannin, antioxidant activity of different spices

If spices aril can be properly utilize, it can broaden the spectrum of medicinal use of spices. This information can help us to use the spices waste and reduce their act as garbage in the environment and also some other uses of spices waste like medicinal purpose, cosmetics etc.



Fig: Burger patties.

Study on flavor, quality characteristics and shelf life of biscuits available in Bangladesh.

In Bangladesh, a number of Food Manufacturers and Bakeries preparing biscuits, yet many importers importing different qualities of biscuits each year. The main reason of importing biscuits is the improved flavor of these biscuits. Though many food producers preparing varieties of biscuits, there is practically no information about the flavour quality of their products. As well as, there is no information about the change in flavour quality of these biscuits during storage. Hence, the present R&D project has been taken to access the flavour quality of biscuits present in market and also to observe the change in flavour quality of these products during storage.

Objectives:

To form a panel of 10 members and train them. To identify the fatty acid composition in biscuit.
To compare the flavor quality of imported and local biscuits.

Work Progress:

A panel of 12 members has been formed and trained them for sensory analysis. Fatty acid composition has completed. Chemical analysis has done. Sensory analysis of local biscuit has done.

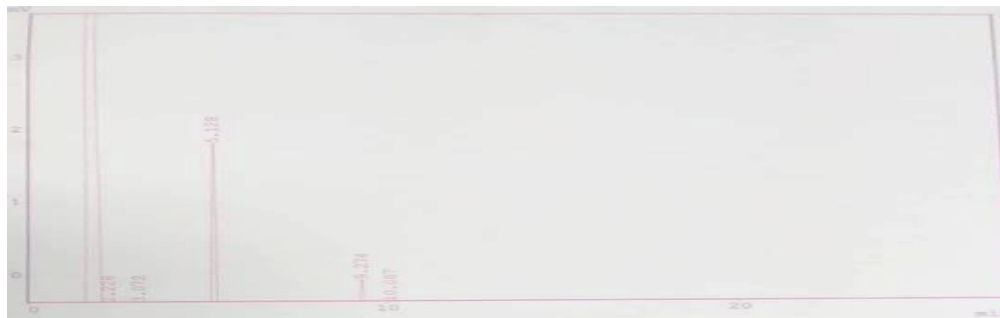


Fig : Chromatogram of fatty acid composition of chocolate flavored biscuit available in local market

Characterization and Utilization of Nonconventional Oilseeds in Bangladesh.

Studies revealed that, plant seeds (vegetable and fruit seeds) are important sources of oils of nutritional, industrial and pharmaceutical applications. Many of them are rich in polyunsaturated essential fatty acids, which establish their utility as “healthy oils”. The present study was undertaken for identification of those locally available plant seeds. It is possible to add value to the seeds by extracting oils and characterize those seeds

Objectives: Identification and utilization of nonconventional oilseeds. Search for new source of oil to mitigate the ever-increasing demand of edible oil. Analyze the physico-chemical characteristics of oil from nonconventional seeds. To find out the antioxidant properties of oilseeds.

Work Progress

: Nutritional analysis of Pumpkin seed, Bottle gourd seed, Bitter gourd seed, White gourd seed, Okra seed and Cucumber seed has been completed. Physico-chemical parameters, fatty acid composition and tocopherol content of these seed oils have been investigated. Refining of Pumpkin seed oil has been done to utilize crude pumpkin seed oil in edible purpose.

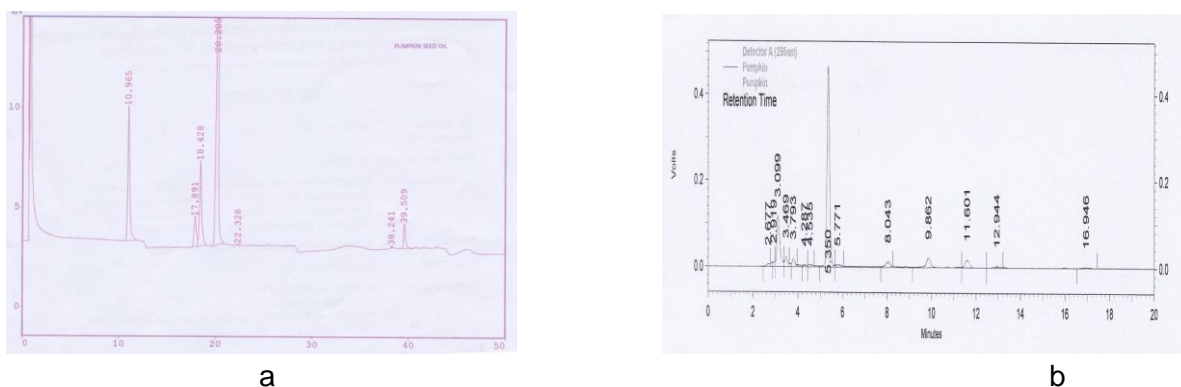


Figure-2: a) Chromatogram of fatty acid composition of Pumpkin seed oil
b) Chromatogram of Tocopherol content of Pumpkin seed oil



Preparation of malted complementary food for elder people.

Digestion capabilities of elder people are weak. Normal diet is not digested in their digestive system. These elder people need easily digestible diet or food to maintain their good health. In preparing malted complementary food for elder people, cereals & pulses seeds are processed through germination for getting nutritionally rich, inexpensive, easily digestible & acceptable flavors products.

Objectives: To produce different types of nutritionally rich malted complementary food for elder people. To make inexpensive food products, the use of locally available raw materials should be ensured. To establish food industries transferring the new technologies/developed food products to the entrepreneurs. To create new employment that will play vital role in poverty reduction.

Work Progress: One paper accepted: A paper entitled "Effect of germination on biochemical changes among three high yielding Barley (*Hordium vulgare* L.) Varieties" is accepted by Bangladesh Journal of Scientific & Industrial Research (BJSIR). Process: One process is developed entitled "Preparation of malted complementary food for elder people"

Hypoglycemic, Hypolipidemic Properties of some selective plants, Fruits and spices (Nelumbo nucifera, Centella asiatica, Moringa oleifera, Azadirachta indica, Palm, Cardamom, Cinnamon, Clve, Coriander, Fennel, Garlic, Ginger, Turmeric etc.) in Steptozotocin and alloxan induced diabetes"

Spices were some of the most valuable items of trade in the ancient and medieval world. Herbalist and folk practitioners have used plant remedies for centuries, but only recently have scientist begun to study the powers of common herbs and spices. In the current set-up, the anti-proliferative, anti-hypercholesterolemic, anti-diabetic, anti-inflammatory effects of spices have overriding importance, as the key health concern of mankind nowadays is diabetes, cardiovascular diseases, arthritis and cancer. Spices or their active compounds could be used as possible ameliorative or preventive agents for these health disorders. Spices are rich in antioxidants, and scientific studies suggest that they are also potent inhibitors of tissue damage and inflammation caused by high levels of blood sugar and circulating lipids. Because spices have very low calorie content and are relatively inexpensive, they are reliable sources of antioxidants and other potential bioactive compounds in diet. This review outlines the role of some spices used in the Indian kitchen for its flavour and taste which are potential to maintain a healthy heart. Currently there has been an augmented interest globally to identify compounds isolated from natural products that are pharmacologically effective and have low or no side effects for use in preventive medicine and the food industry.

Objectives

: To measure antidiabetes effect of some selective plants and spices and identify their mode of action. To measure lipid lowering effect of that spices

Work Progress: Three Papers published

Development of Therapeutic Diets for Malnourished persons (phase-1)”

Malnutrition is widespread and has been recognized as a public health problem in Bangladesh. Bangladesh has one of the highest rates of child and maternal malnutrition in the world, say health experts. A Unicef report says millions of children and women in Bangladesh are suffering from more than one form of malnutrition. According to the State of the World's Children (SOWC) Report 2008, issued by the UN Children's Fund (UNICEF), eight million or 48% children under-five are underweight. Levels of malnutrition in Bangladesh are amongst the highest in the world, and this is a major cause of death and disease in children and women. The economic consequences of Bangladesh's malnutrition problem are profound, resulting in lost productivity excess morbidity, elevated risks of heart disease and diabetes, reduced intellectual and learning capacity.

Objectives: To develop different types of Therapeutic diets from indigenous sources for malnourished children, elderly persons, women and specific diseased persons (Diabetes, hypertension, diarrhea etc).

Progress Achieved: Ongoing

Toxicological impact on Long Events rat through deposition of Heavy Metals (eg. Methyl Mercury) in indigenous fishes.”

Environmental pollution has become a factor of rapid change in life condition. In this respect aquatic system are especially vulnerable, as they eventually accumulate all kinds of pollutants. To date water quality in all large lakes rivers has changed. Of the many different toxic compounds present in aquatic ecosystems, the heavy metals are considered by some to be the most hazardous. It is clear that the anthropogenic input of heavy metals is much higher than the natural input. For example, anthropogenic input in almost double the natural input of mercury, and copper, lead, and zinc it is greater by an order of magnitude.

Objectives: To acquaint toxic substance which are mostly found in fresh water fishes from rivers. (Industrial Zone)To find out toxic substances like methylmercury from specific species.To find out rapid evolution in molecular level (fresh water fishes)To study on chemical toxicants including inorganic & organic substances such as lead, mercury, asbestos, hydrofluoric acid, methylalcohol etc.To measure LC₅₀ in Industrial discharge which are polluted open water.Find out suitable Way to eradicate open water pollution

Progress Achieved: One Paper published.

Effects of some selected spices and plants on cardiac enzyme markers through molecular analysis and gene expression profiling.

Life-threatening disorders like coronary heart disease, cerebrovascular, peripheral arterial, rheumatic heart, congenital heart diseases, deep-vein thrombosis, and pulmonary embolism are

caused due to impairment of heart and blood vessels, and they are collectively known as cardiovascular diseases (CVDs). In this perspective, traditionally used some common spices such as *Cinnanomum zeylanicum*, *Allium sativum*, *Zingiber officinale*, *Syzygium aromaticum* and plants *Nelumbo nucifera*, *Azadiracta indica* that have a distinct place in folk medicine in several of the Asian countries as well as on their traditional uses for the role they can play in the management of CVDs has been taken into consideration for comparative efficiency on cardio-protective activity by gene expression profiling, studying the lipid profile and histological study.

Objectives: To evaluate the effects of some selected spices and plants on cardiac enzyme markers. To evaluate the effects of some selected spices and plants on lipid profile. To do the gene expression profiling. To examine the cardiac histology. To identify the therapeutic targets for clinical development.

Progress Achieved: Ongoing

Heavy Metal Contamination in Dhaleshwari River Water and on Surface Soil in the Visibly of Tannery Industries.

huge quantity of dissolved salt will be discharged into the Dhaleshwari river from the Savar Tannery Industrial Estate as the Central Effluent Treatment Plant (CETP) there doesn't have the component needed for desalinizing wastewater. Even if all the other toxic materials are treated, the salt will kill the biodiversity of the river, say environmentalists. The country's tannery industry uses around 40,000 tones of salt annually. Environmental pollution has become a factor of rapid change in life condition. In this respect aquatic system are especially vulnerable, as they eventually accumulate all kinds of pollutants. To date water quality in all large lakes rivers has changed. Understanding the adverse effects of industrial discharge on food circle, environmental aspects and safety margins of those wastes through this study will guide us with safeguard measures in mimicking the situation This study will open the door to have comment on different areas like food safety especially with respect to fish, quality of surface water, fish loss, biodiversity loss, quality of life, environmental and ecosystem impacts.

Objectives:

To analyze the fresh water & Soil of Tannery effluent area for the presence of lethal pollutants especially carcinogenic heavy metals. To acquaint toxic substance which are mostly found in fresh water & Soil from Dhaleshwari River. (Tannery Zone). To find out rapid evolution in molecular level (water & Soil) To study on chemical toxicants including inorganic & organic substances such as lead, mercury, asbestos, hydrofluoric acid, methyl alcohol etc. To measure LC₅₀ in industrial discharge which are polluted open water. Find out suitable Way to eradicate open water pollution.

Progress Achieved: Ongoing

Screening of Polychlorinated Biphenyl (PCB) contamination level in soil and water of possible affected industrial areas in Bangladesh.

For the last few decades, several persistent organic compounds have been synthesized and released into the environment for direct or indirect application. Among them; polychlorinated biphenyls (PCBs) are known as environmental and human health concern. Therefore, PCBs were listed in the Stockholm Convention as one of twelve Persistent Organic Pollutants (POPs), due to their resistant to chemical, physical and biological degradation and being ubiquitously found in all environments of the earth. PCBs are odorless, tasteless, colorless or light color synthetic chemical compounds. They have extremely high boiling points and are nonflammable chemicals which were primarily used in transformers and capacitors and also in many other industrial applications such as lubricants, flame retardants, plasticizers and paint additives. PCBs are amongst the industrial chemicals and have no known natural sources in the environment but they entered the environment through many anthropogenic sources including leakages of PCBs containing transformer oils, waste disposals and by the burning of some wastes in municipal and industrial incinerators. PCBs have been found world-wide in the regions far from their original sources and known as Long Range Atmospheric Transport (LRAT) pollutants.

Polychlorinated biphenyls (PCBs) are classified as probable human carcinogens (Group B2) by Environmental Protection Agency (EPA), and International Agency for Research on Cancer (IARC) has included these chemicals in Group 2A of carcinogens with wide range of health effects including carcinogenicity, neurological and reproductive disorders, and suspected hormonal disorders. But few studies have been found that address the environmental contamination of PCB in Bangladesh. So, it is now becoming inevitable to screen the level of contamination of PCBs in environment which will give an overview of the present situation in order to take necessary steps to restrict the import and use of these pollutants.

Objectives: To detect the current level of contamination of PCBs in soil, sediments and water of different industrial zones. To develop the methods to analyze these pollutants from different soil, sediment, and water samples

To support the environment monitoring authority for ensuring law enforcement agencies to strictly prohibit the use of these pollutants.

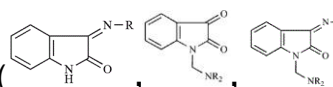
Progress Achieved: Ongoing

Synthesis, Characterization and Biological Activity Study of some Isatin based Schiff bases () and Mannich Bases (). (Phase-I)

Schiff bases (

Schiff bases^[1] and Mannich bases^[2] are well known for anti cancer and cytotoxic properties. Schiff bases are condensation products of primary amines with carbonyl compounds gaining importance day by day in present scenario. Schiff bases are the compounds carrying imine or

azomethine ($-C=N-$) functional group^[3] and are found to be a versatile pharmacophore for design and development of various bioactive lead compounds. Schiff bases exhibit useful biological activities^[1] such as anti-inflammatory, analgesic, antimicrobial, anticonvulsant, antitubercular, anticancer, antioxidant, anthelmintic, antiglycation, and antidepressant activities. Schiff bases are also used as catalysts, pigments and dyes, intermediates in organic synthesis, polymer stabilizers, and corrosion inhibitors. Mannich bases are the end products of Mannich reaction and are known as beta-amino ketone^[4] carrying compounds. Mannich reaction is a carbon-carbon bond forming nucleophilic addition reaction and is a key step in synthesis of a wide variety of natural products, pharmaceuticals^[2], and so forth. Mannich reaction is important for the construction of nitrogen



Objectives: Synthesizing some cytotoxic compounds () those are expected to have anti-cancer & cytotoxic properties.

Progress Achieved: One paper published

Investigation on the synergistic hepatoprotective effects of selected plant extracts and their antioxidant activity through gene expression analysis.

Alternative drugs in the form of Herbal, Unani, Ayurvedi and Shiddha have opened a new avenue of healthcare systems which has an approximate of \$60 billion market size over the world and its increasing 15-20 percent every year. This is why, the aim of the proposed study is to investigate the compounds, in (*Cajanus cajan*, *Asparagus racemosus*, *Carissa opaca*, *Cassia fistula* etc.) comprising of antioxidant activity followed by the establishment of those compounds as pharmaceutical dosage form or as herbal medicine. Finally, herbal medicines are widely used for treatment of different diseases. It is one of the alternatives; people are turning to and can save from harmful side effects induced by powerful, synthetic, allopathic drugs. For use of herbal medicine as alternative approach of hepatoprotective treatment, it is essential to know about herbal medicine properly. It is also important to know how a plant is selected for research to verify that either it has anti-oxidative property or not, and the selected plant are toxic or not. To know about a local plant for its medicinal property the following topics must be considerable. New sources of herbs could also be effectively established for the treatment of inflammation as well as in conventional antibiotic resistance.

Objectives: Standardize the raw extracts of selected plants (*Cajanus cajan* (arhar), *Asparagus racemosus* (shatamuli), *Carissa opaca* (koromcha), *Cassia fistula* (shonalu) etc). To standardize the raw extracts of selected plants (*Cajanus cajan* (arhar), *Asparagus racemosus* (shatamuli), *Carissa opaca* (koromcha), *Cassia fistula* (shonalu) etc). To assay the antioxidant activity of the organic extracts of plant mixture (*Cajanus cajan* (arhar), *Asparagus racemosus* (shatamuli), *Carissa opaca* (koromcha), *Cassia fistula* (shonalu) etc). Study the *In vivo* hepatoprotective activity of the organic extracts of plant mixture (*Cajanus cajan* (arhar), *Asparagus racemosus* (shatamuli), *Carissa opaca* (koromcha), *Cassia fistula* (shonalu) etc). Investigate the synergistic hepatoprotective effects of plant extracts (*Cajanus cajan* (arhar), *Asparagus racemosus*

(shatamuli), *Carissa opaca* (koromcha), *Cassia fistula* (shonalu) etc) at molecular level through gene expression analysis. To isolate and identify the phytochemical lead active compounds

Progress Achieved: Ongoing

Cereal Based Functional Foods for Young Children.

Functional foods can be considered to be those whole, fortified, enriched or enhanced foods that contain adequate amounts of biologically active components in addition to their basic nutrients that provide health benefits beyond the provision of essential nutrients (e.g., vitamins and minerals), when they are consumed at efficacious levels as part of a varied diet on a regular basis. Such foods improve the general condition as well as physical condition of human organisms and /or decrease the risk of disease. Several cereal-based (rice, oatmeal, semolina, green banana) and chicken- based diets have been found to be clinically useful. Specially green banana is rich in amylase-resistant starch (ARS), which has been reported to protect against chemically induced damage of gastrointestinal mucosa in animals. Thus the resistant starch of green bananas seems to be potential therapeutic agents for diarrhoea. There is no such food containing these essential ingredients have yet been produced or assessed in our country, so the attempt has been taken to develop the cereal- based functional food.

Objective: The main objective of this research project is to develop and evaluate prebiotic containing cereal-based functional food for young children, which is cheap, easily accessible and have biologically active components to reduce disability and death among children due to infectious disease.

Progress achieved: The nutritional analyses of a developed cereal- based food product with green banana are going on. Development of a process for the production of instant noodle containing resistant starch for young children is going on. Four research papers and two abstracts have been published. Isolation of functional ingredients is going on.

Investigations on the preparation of protein and vitamin A enriched foods to combat Nutritional diseases.

Marasmus & Night blindness diseases are common in poor people living in under developed countries. Carotene is found in naturally abundant deep green leafy vegetables. It also found in yellow colour fruits and vegetables. Intake synthetic vitamin A is harmful in human body. Pulses, legumes and nuts are rich sources of plant protein. Protein & vitamin A enriched foods are a good combination to reduce nutritional diseases. The processing technology will also be useful for the development of agro based industries in our country.

Objectives: To develop protein and vitamin A enriched foods using Plant protein (Legumes and Pulses) and rich sources of Vitamin A (e.g. Carrot, Aroid leaves, Pumpkin, Drumstick leaves, Spinach etc). To prevent marasmus and night blindness among preschool and school age children. To improve the overall nutritional status of the children.

Progress Achieved: Three protein and vitamin A enrich food have been developed. Name of the developed product. 1 Breakfast item 2 . School Tiffin item 3. Emergency Food for Disaster Dietary Management.

Validation of food borne pathogen both aerobic and anaerobic bacteria detection method from food samples through Polymerase Chain Reaction (PCR) compared with standard cultural method and also with immunological method.


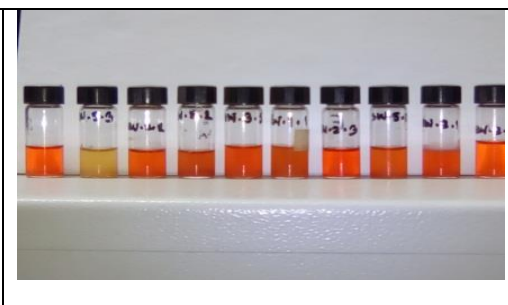
It is important to consider food from production to consumption for assurance of food safety upto consumer level. High priority is given by the U.S. food and drug administration to save people from microbial contaminated diseases (Hill 1996). Microorganisms are detected in food samples by visual, biochemical, molecular (e.g. PCR, sequencing) and/or immunological methods either before or after enrichment. Traditional culture methods are based on the visual confirmation of their growth by direct inoculation of food sample in nutrient medium. The advantages of this method are its simplicity, easily adaptable and inexpensive. The major weaknesses of these methods are laborious and time consuming as depend on the growth of the microbes in different culture media (pre-enrichment, selective enrichment, selective plating and identification), which may require several days to find out the outcome. Products that are minimally processed have an inherently short shelf life, which prevent the use of many of these conventional methods. Therefore, molecular detection practice of bacteria now is becoming popular, reliable and fast process for enumeration of bacteria in the field of microbiology.

Objective:

Extraction and purification of bacterial genomic DNA from food and water samples. Specific genes are detected by PCR to identify food borne pathogen and also to detect pathogenic genes. To compare the sensitivity of PCR based detection with culture based detection and immunological assay. Identification of anaerobic food borne pathogen which has culture and technical limitation.

Progress Achieved:

A no. of strains of pathogenic organism have been isolated and identified from the food samples, clinical samples and environmental samples. Antibiotic sensitivity test were performed. Isolated bacteria were also trialed on their biodegradation ability. PCR of bacteria was also carried out by detecting pathogenic genes.

	
<p>Culture of pathogenic bacteria</p>	<p>Reactions of pathogenic bacteria in culture broth</p>

Achievements:

Research Papers

Mohajan S., Orchy T.N. and Farzana, T., “Effect of incorporation of soy flour on functional, nutritional and sensory properties of mushroom-moringa supplemented healthy soup”, *Food Science and Nutrition*, 6(3), 549–556, 2018.

Farzana T., Mohajan S., Saha T., Hossain, M.N, and Haque, M.Z., “Formulation and nutritional evaluation of a healthy vegetable soup powder supplemented with soy flour, mushroom, and moringa leaf”, *Food Science and Nutrition*, 5(4), 911-920, 2017.

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Robel P., Marzia S., Marium K., Zahurul H., Sahana P., “Resistance Genotyping Profile of Extended-Spectrum Beta-Lactamase (ESBLs)-, AmpC Beta-Lactamase (ESBL/AmpC) and Carbapenemase (ESBL/Carbapenemase)-Producing *Escherichia coli* Isolated from Clinical, Food and Environmental Lake Water in Bangladesh” *Advances in Applied Science Research*, 2017, 8(3):23-31

Mohammad Nashir Uddin, Ajit Kumar Majumder, Abu Tareq Mohammad Abdullah, Md. Alamgir Kabir. Chemometrics Assisted Method for Classification of Mango Juice as Adulterated or Safe with over Use of Artificial Colours by UV Spectroscopic Data. *Journal of Food and Nutrition Sciences*; 2017; 5(2): 51-56

Fahad Ahmed, A. N. M. Fakhruddin, MD. Toufick Imam, Nasima Khan, Abu Tareq Mohammad Abdullah, Tanzir Ahmed Khan, Md. Mahfuzur Rahman, Mohammad Nashir Uddin. Assessment of roadside surface water quality of Savar, Dhaka, Bangladesh using GIS and multivariate statistical techniques. *Appl Water Sci* (2017) 7:3511–3525.

Kabir M.A., Khan S., Lisa S.A. and Islam F. “Quality of oils used to prepare French Fries in Dhaka city.” *Bangladesh Journal of Scientific and Industrial Research*, 53(2), 117-124, 2018.

Rupa, A.Z., Sarkar, P., Rahman, M.M., Shahjadee, U.F., Rahman, M.M. and Rahman, M.M. “The effect of germination and metallic salts on the stability of enzymes of three high yielding varieties of maize (*Zea mays* L.) in respect of Bangladesh.” *Journal of Food Research, Malaysia*

Rupa, A.Z., Sarkar, P., Rahman, M.M., Shahjadee, U.F., Rahman, M.M. and Rahman, M.M. “Amino acids, enzyme activity and effect of chemical agents, metallic salts on the stability of α -amylase, protease from aloe vera plant, Bangladesh” *journal of Botany* 46 (4) : 1375-1379,2017 (December).

Tanzima Yeasmin, Hanif Ali, Rumana Yesmin, Majidul Islam, Akter Hosen, Rawshanul Habib, Mohammed A Satter, “Growth Inhibition and Apoptosis of Ehrlich Ascites Carcinoma Cells by Methanol Extract from the Calyx of *Hibiscus Sabdariffa* Linn.” *KM Faisal Haque. CAJMS* 2018; 4(2): 155-165.

Mst Mehrunnahar, M Mozammel Hoque, Mohammed A. Satter, Nusrat Abedin and M. Faridul Islam Evaluation of Nutritional and Functional Status of Three Varieties of Foxtail Millet Cultivars in Bangladesh.”. BangladeshJ Bot. 2018; 47(2): 301-306.

Hanif Ali, Rumana Yesmin, Mohammed A Satter, Rawshanul Habib, Tanzima Yeasmin “Antioxidant and antineoplastic activity of methanolic extract of *Kaempferia galangal lin.* Rhizome against Ehrlich ascites carcinoma cells”. J King Saud Univ.- Science. 2018; 30: 386-392.

Majidul Islam, Rumana Yesmin, Hanif Ali, Polash Chandra Karmakar, Rawshanul Habib, Mohammed A Satter and Tanzima Yeasmin “Chemical Composition and Anticancer Properties of *Alpina calcurata* Rosc. Rhizome.”. J Pharmacog. Phytochem. 2017; 6(5): 2491-2494.

Dipa I., Amdadul H., Liton C. M., Evena P. L., Md Nazibur R., Abida S., UK Sheuly, Studies on the Hypoglycemic and Hypolipidemic Effects of *Nelumbo nucifera* Leaf in Long-Evans Rats, Journal of Diabetes Mellitus,2017,7,55-70. doi:10.4236/jdm.2017.73005

Dipa I., Amdadul H., Liton C. M., Sheuly, Sadhan K. D., Abida S., Evena P. L., UK Proadhan. Hypoglycemic and hypolipidemic effects of *Nelumbo nucifera* flower in Long-Evans rats. Journal of Herbmed Pharmacology. J Herbmed Pharmacol. 2018;7(2):x-x. doi:10.15171-jhp.2018.0x

Dipa I., Afsana A., Amdadul H., Samina A., Dipankar C. R., Chadni L., Mahmuda H., Liton C. M., Evena P. L., Md Abubakkar S., Khan Md Murtaja R. L., Md Nazibur R. Hypoglycemic Effect Study of a Combination of Some Stipulated Spices in Alloxan Induced Diabetic Wistar Albino Rats along with Nutritional Value Evaluation. Journal of Diabetes Mellitus,2018,8, 43-53. doi:10.4236/jdm.2018.82005

Participation in Foreign Training:

1) Md. Faridul Islam, SSO has participated and Completed successfully the training on “Laboratory Testing for Micronutrients of Rice Premix Kernels)” conducted by Joint Institute for Food Safety and Applied Nutrition (JIFSAN), USA, from 12 to 21 December 2017.

Award:

Scientists pursuing M.S/M.Phil/Ph.D. Courses in home or abroad:

1. Monzur Morshed Ahmed, Microbiology Division, Industrial Microbiology Section, working as a member in Food Safety Authority, on Deputation.

2. Md. Nur Hossain, Microbiology Division, Industrial Microbiology Section, Pursuing PhD in Food Science Department, University of Melbourne.

3. Shakir Uddin Ahmed, Microbiology Division, Food Microbiology Section, Pursuing PhD in Tuskegee University, USA

Academic Research Guidance/Supervision:



Sl No.	Title of research (font: Arial 12)	Research category (font: Arial 12)	Name of students (font: Arial 12)	Name of academic institution (font: Arial 12)	Name of supervisors in BCSIR (font: Arial 12)
1.	Pathotyping of <i>E.coli</i>	MS Thesis	Iqbal Mahmud	Dept. of Microbiology Noakhali Science and Technology University	Mohammad Robel Hossen Patwary, SO
2.	Molecular Genetics of ESBL <i>E. coli</i>	MS Thesis	Shamima Nasrin	Dept. of Microbiology Noakhali Science and Technology University	Mohammad Robel Hossen Patwary, SO
3.	Antioxidant capacity and mineral contents of Bangladeshi mushroom	MS Thesis	Afsar Uddin	Dept. of Biochemistry and Molecular Biology, Tejgaon College, Dhaka	Dr. Tasnim Farzana, PSO
4.	Formulation & evaluation of nutritional profile of mushroom fortified noodles and its comparison with locally available noodles	MS Thesis	Rezoana Parvin	Dept. of Applied Nutrition & Food Technology. Islamic University Kushtia	Dr. Tasnim Farzana, PSO
5.	Formulation & evaluation of nutritional, sensory and	MS thesis	Rozina Akter	Dept. of Biochemistry and Molecular Biology, Shahjalal	Dr. Tasnim Farzana, PSO

	phytochemical properties of a mixed cereal based cake			University of Science & Technology, Sylhet	
6.	Development of a nutritious biscuit using phytonutrient enriched cereals and its comparison with locally available similar products	MS thesis	Tasnim Farhana Eyerin	Dept. of Biochemistry and Molecular Biology, Shahjalal University of Science & Technology, Sylhet	Dr. Tasnim Farzana, PSO
7.	Improving Burger Meat Quality using <i>Zingiber officinale</i> Rosccoe Extract (Ginger)	MS thesis	Atia Hamida Epsita	Dept. of Food Engineering and Tea Technology, Shahjalal University of Science and Technology	Tanzir Ahmed Khan, SSO
8.	Nutritional category, physiochemical and functional properties of foxtail millet and its blend for noodles production	PhD Thesis	Mst. Mehrunnahar	Shahjalal University of Science and Technology	Dr. Md. Abdus Satter Miah
9.	Comparison of biochemical analysis of foxtail millet noodles with commonly consumed noodles production in	MS thesis	Abdullah-Al-Noman	Shahjalal University of Science and Technology	Dr. Md. Abdus Satter Miah

	Bangladesh				
10.	Evaluation of Cardio protective effects of Mixed Spices on Hyperlipidemic Wister Albino Rat.	M.S.	Afsana Akter	Mawlana Bhashani Science and Technology University	Dipa Islam
11.	Determination of antimicrobial activity spices.	M.S.	Kaysari Afroz Pasha	Stamford University	Dipa Islam
12.	Combined antioxidative effect of sum selected plants on CCL4 induced Wister albino rats	M.S.	Ahad Shah	Shahjalal University of Science and Technology	Evena Parvin Lipy
13.	Therapeutic Biscuit Development against Malnutrition for School Age children and Adolescents.	M.S.	Priyom Kumar Saha	Shahjalal University of Science and Technology	Dipa Islam
14.	v. Determination of Antioxidant of some combined spices and study of their effect on biological functions in rat model	M.S.	Sadiya Arefin	Mawlana Bhashani Science and Technology University	Dipa Islam

15.	vi. Investigating the synergistic molecular effects of spices mix on isoproterenol induced myocardial infarction in rats through caspase-3 gene regulation	M.S.	Md. Abdullah-Al-Mamun	Khulna University	Dipa Islam
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Pictures:

	
HPLC	Functional Food for Young Children.

Institute of Glass & Ceramic Research and Testing (IGCRT)

“Institute of Glass and Ceramic Research and Testing (IGCRT)” is the 4th mono disciplinary unit of BCSIR, emerged as institute in the year 2001 through the up-gradation of the “Division of Glass and Ceramic Technology” of BCSIR Laboratories Dhaka which was functional since 1955. The institute is a premier R&D organization dedicated to produce value added ceramic products through recycling of various industrial waste/by-products, to carry out R&D program in the field of glass, ceramic, refractories, building materials, inorganic pigment as well as on traditional ceramics, allied materials for the strategic needs and also for the industrial and economic development of the country.IGCRT is poised to take on the challenge of the new millennium with the development of several new products and processes for future requirement.



1. R & D Activities:

Ceramic Research Division

Modifications of ceramic water filter using locally available raw materials and its applications in polluted water.

The use of water filter is increasing day by day because of crisis of pure water. To materialize the goal it is necessary to make access to improve water supply at a rate-100.00 people per day between the year 2000 and 2015. It is very difficult to meet this ambitious goal by government alone. Household ceramic water filter provide an affordable means to treat contaminated water to a suitable drinking water. Raw materials and water filter are imported from abroad. As a result, Bangladesh spends much money to import these. So to reduce the dependency of imported ceramic raw materials and save the foreign money, the new process is important for Bangladesh.

Objective:

1. Removal of blocked with excess iron content water passing through water filter and improvement of lasting long of water filter
2. Preparation of anti bacterial properties of ceramic water filter using waste activated carbon

Progress: Various batch compositions of ceramic water filter are made using waste activated carbon and their physical-mechanical properties are determined. The anti bacterial test of ceramic water filter, water passing through the water filter will be determined.



Ceramic water filter

Corrosion Behavior of Low Cost Nano-Si Ceramics in Atmospheric Environment

Nano Si ceramics are promising materials for photovoltaic application. As solar cell finds more applications in atmospheric environment, oxidation in oxidant and thus corrosion becomes an important concern of study. The rapid oxidation in water or moisture in humid air appears to be a major concerned. In this project, the critical issue, corrosion in this field will be surveyed. In

general, the solar cells are encapsulated with the EVA (ethylene vinyl acetate). Due to the delamination of the EVA causing active corrosion of nano Si ceramics substrates and thus life time of solar cell decreased. So if we monitor corrosion of nano-Si ceramic substrate by exposing in water or atmospheric humid environment and could prepare corrosive resistant nano-Si substrate (surface area: 25-250 m²/gm), then life time and performance of solar cell will be increased.

Objectives:

1. Synthesis of nano Si ceramics by laboratory O/W microemulsion method.
2. Monitoring corrosion of prepared ceramics by TGA (Thermal Gravimetric Analyzer) so that we can prepare corrosion resistive Nano-Si ceramics substrates of high life time and efficiency.

Work progress:

1. Water in oil (w/o) composition of microemulsions were prepared.
2. Si nanopowders were prepared with Reverse Microemulsion Precipitation Method.
3. Measurement of XRD, SEM-EDX of Si nanoparticles were completed and proceed for characterization by TGA.

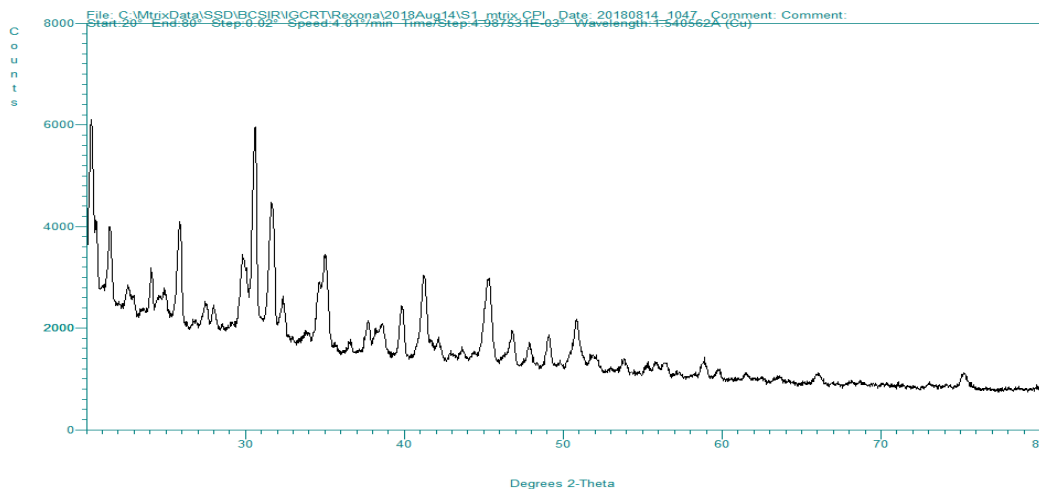


Figure 1. XRD image of Si Nanoparticles.

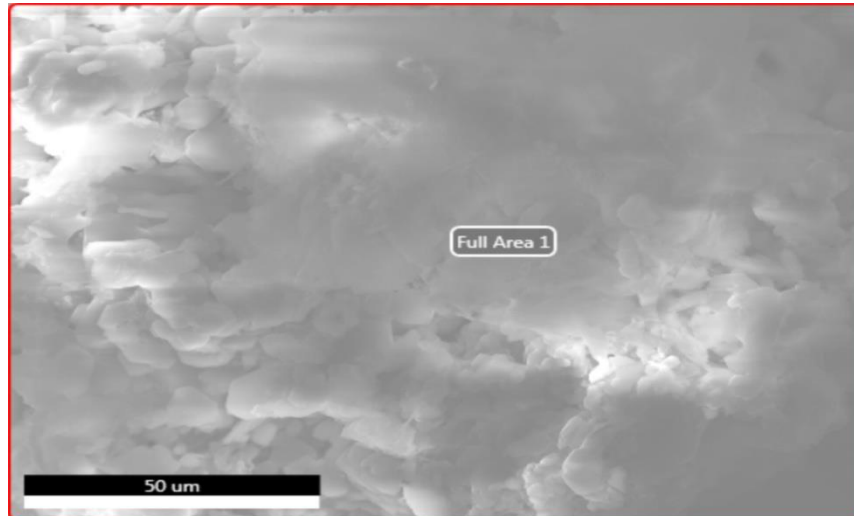


Figure 2: SEM image of Si nanoparticles.

Development of glass ceramic materials using Fly ash, waste glass & ceramic powders by incorporating nucleating agents and characterization of the products

In Bangladesh, Glass-Ceramic Articles such as Advanced Nano-Ceramic Sensors, Semiconductor, Thermal Barrier Coatings, Optically Transparent Components, Crystallized Glass, Tableware, and Building Materials are carrying increasing demands. However, no industries are available here and every year loads of Glass-Ceramic Articles are to import.

Waste management and recycling is an important aspect of environmental sanitation. It also reduces the exploitation of run-materials for the purpose of production. Glass - ceramics raw - material is obtained by digging landfills, which leads to the distortion of the environment.

Objective:

1. Preparation of High-quality Materials such as Advanced Nano-Ceramic Sensors, Semiconductor, Thermal Barrier Coatings, Optically Transparent Components, Crystallized Glass, Tableware, Building Materials.
2. Preparation of glass-ceramic Tiles using waste materials of Bangladesh like Rice husk ash, waste glass, fly ash etc



Glass- ceramic Tiles

Ceramic Raw Materials and Ceramic Materials Testing Division

Production of magnetic red oxide from iron containing waste materials

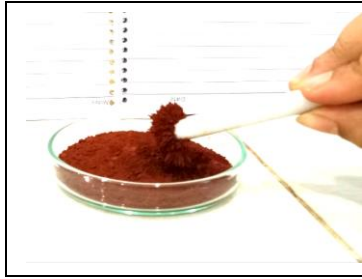
Iron containing waste materials such as condensed milk can, beverage can, coconut oil can etc and industrial waste such as mill scale, iron sludge, iron dust are waste materials from more than 250 steel industries and iron scrap from CNC mill machine are the raw materials of this project. Production of magnetic red oxide from these waste materials is the target of this research work. Magnetic red oxide is used for the production of electronic parts such as magnetic data storage media, magneto-optical devices, magnetic refrigeration, ATM cards, semiconductors and so on.

Objective:

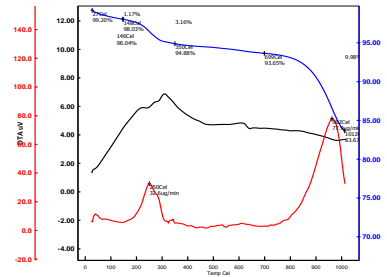
- To reduce the waste disposal problems by recovering and recycling of valued materials.
- Development of a process technology for the production of magnetic red oxide.

Progress:

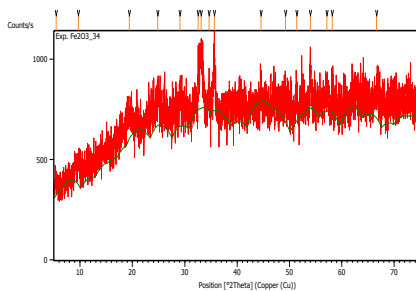
- Collection of raw materials such as condensed milk can, beverage can, coconut oil can etc. from local tea stall and restaurant, mill scale, iron sludge, iron dust from Bandar Steel Industry, Narayangang and iron scrap from CNC mill machine, PP&PDC, BCSIR and analyzed them.
- Development and optimization of process technology for the production of magnetic red oxide are done successfully.
- Characterization of magnetic red oxide by FT-IR, XRD, TG-DTA and magnetic properties analysis by VSM of the synthesized magnetic red oxide are done.



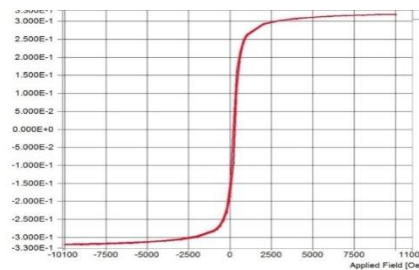
Magnetic red oxide



TG-DTA curve of intermediate product



XRD pattern Magnetic red oxide



VSM pattern Magnetic red oxide

Fabrication and Characterization of a Ceramic magnet (strontium ferrite) to use in electrical motor for automobiles.

Ceramic magnets are mainly known as hard ferrite, which is a part of electro ceramic. Electro Ceramic are truly high tech material. The target of this project is to develop a Ceramic Composite, which will be used as Ceramic core in motor. The demand of Ceramic core for motor is millions and millions. At present core is made of metal that evolves heat and consumes much electricity. If this metal-core is replaced by Ceramic core, it will save electricity as well as it is cheaper.

Objective:

- Synthesis and Characterization of strontium ferrite, a M-type hexaferrite.
- Design and molding as core for use in electric motor for automobiles.
- Application in an electric motor as core.

Progress:

- Strontium ferrite has been synthesized by two different methods: Co-precipitation method and Sol-gel method.

- XRD and VSM analysis of the synthesized product produced from two different methods has been done.

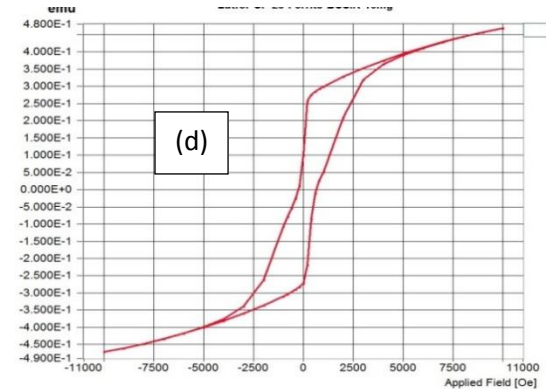
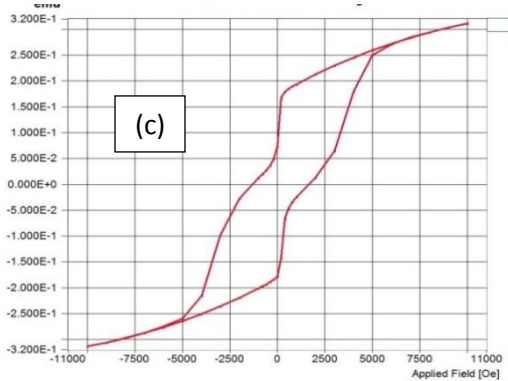
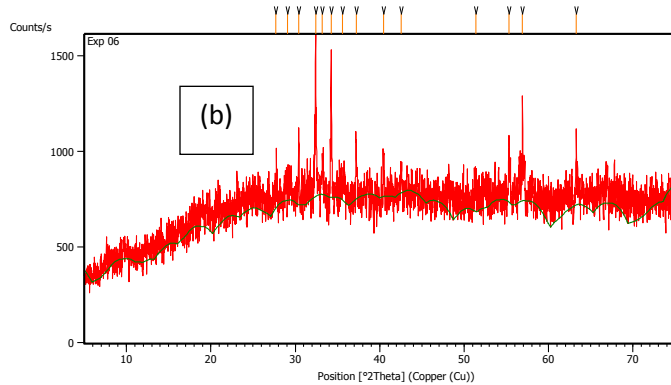
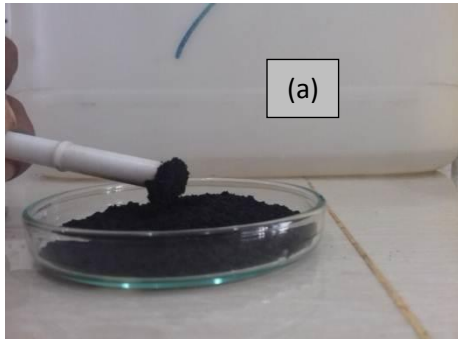


Figure: (a) Picture of the product (b) XRD pattern of the product, VSM analysis report of the product obtained by (a) Co-precipitation method and (b) Sol-gel method

Production and characterization of deflocculating agent for tiles sector

Deflocculating agent is mainly used for slip deflocculation. However, it also improves the mechanical strength of dry pieces, lowers the viscosity during wet-grinding make the grinding operation faster, thus reducing power consumption. In tiles industry, deflocculants is used 0.4%-1.0% with raw materials. So, huge amount of deflocculating agent is used in only tiles industry.

Objectives:

- Production of deflocculating agent.

- Characterization and determination of physical and chemical properties for industrial applications.
- Mitigate the demand of deflocculants in Bangladesh.

Progress:

- After collection and processing major raw materials like sand and quartz are analyzed.
- Production of deflocculating agent and optimization of process parameter is going on.

Preparation of nano black iron oxide

Objectives:

- Synthesis of black iron oxide nano particles
- Optimization of the process technology for cost minimization
- Characterization of the synthesized product
- Application of black iron oxide nano particles in different areas like diagnostic, pharmaceutical, biomedical and industrial.

Brief Description:

At present iron oxide, nanoparticles (IONPs) have attracted much consideration due to their unique properties, such as superparamagnetic, surface-to-volume ratio, greater surface area, and easy separation methodology. IONPs have been widely used in diagnostic, pharmaceutical, biomedical, in construction, coatings, ceramics, paint, rubber, plastics, cosmetics etc. due to its magnetic as well as nano scale range of particle size and as highly active catalysts. Therefore, the target of this project is to prepare black iron oxide nanoparticles and develop the process and if the scientists develop the process, it will create the opportunity of employment by industrialization and save the foreign currency.

Progress:

1. The project period was July 2017-June 2019 but it was approved on 21 January 2018.
2. Literature review and some preliminary works are going on.

Enamel Research Division

Development of an eco-friendly high performance nano-ceramic coating

Chromate has been reported as the most efficient widespread conversion coatings for the corrosion protection of many metallic substrates. But chromium is ranked among the top toxic and carcinogenic substances. So, in this project environmentally acceptable surface treatment based on silica and titania have been developed by sol-gel method.

Objective: To develop eco-friendly nano-ceramic coatings for corrosion resistance with attractive mechanical properties of the aluminum alloy.

Progress:

- Nano-ceramic coating with high thermal stability has been successfully applied on aluminium alloy.
- TG-DTA curve of the cured sample as shown in the Fig.1 demonstrates very small weight loss in the temperature range of 30-1000°C.

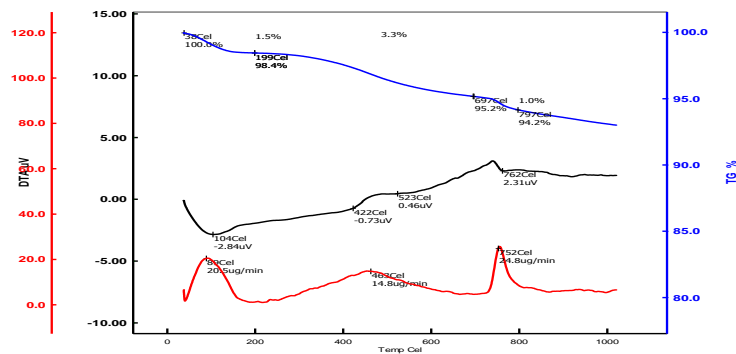


Fig. 1. TG-DTA analysis of nano-ceramic coating.

Development of permanent self-cleaning coating on glass by nano-technology

As Bangladesh has a high demand of window glass and the developed glass will get the attractive features like self-cleaning, better views and excellent hydrophilic or hydrophobic properties, new horizon will be created in the socio-economic development of Bangladesh. Besides, low maintenance self-cleaning glass uses natural daylight and rainwater and thereby saves time, money and water.

Objective: To develop a nano-technology based transparent film coating and thereby to reduce window cleaning.

Progress:

- Hydrophobic nano-ceramic coating on glass substrate has been successfully developed as confirmed by static contact angle measurement (Fig. 1 & 2).

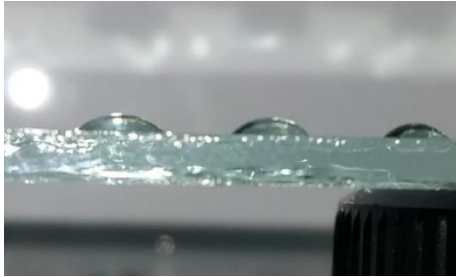


Fig.1. Photograph of water droplet (5 μ L) on non-coated glass (contact angle, $\theta=30^\circ$)

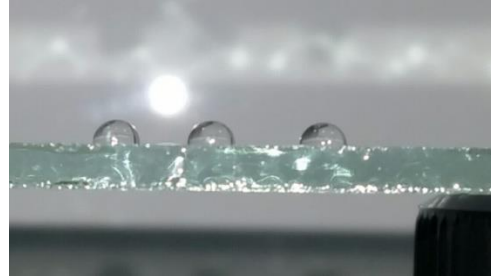


Fig.2. Photograph of water droplet (5 μ L) on nano-ceramic coated glass (contact angle, $\theta=90^\circ$)

- Diffuse reflectance was raised and transmittance was decreased for both tin and air sides of the sample. It indicates that the coated glasses can also be used as solar reflective glass (Fig.3).

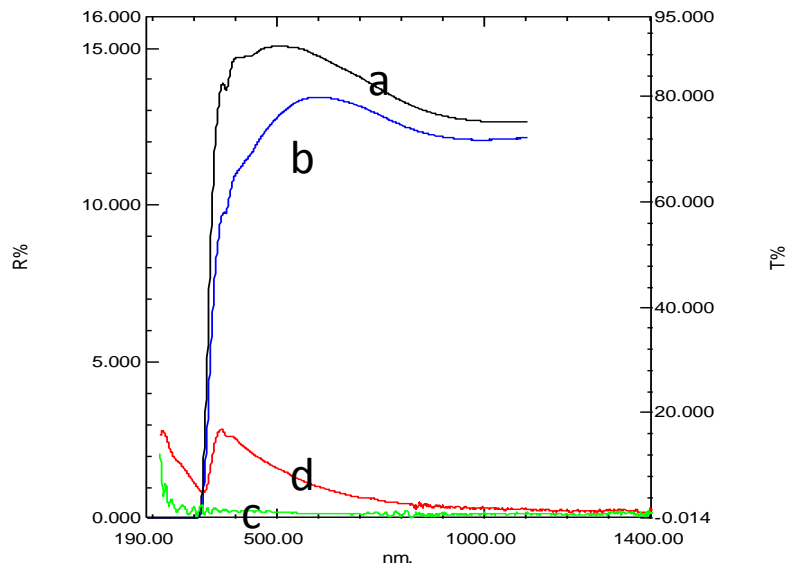


Fig.3. Diffuse reflectance and transmittance of before and after coated glasses from exp.-38 facing tin side at the incident light.

a- transmittance before coating, b- transmittance after coating, c- diffuse reflectance before coating, d- diffuse reflectance after coating.

Glass Research Division

Drug loaded multi-component bio-ceramic matrix for biological applications

The demands for bio-ceramic materials as substitute material for bone and teeth and in biological applications are increasing day by day. Particularly bio-ceramic materials having drug loading and drug releasing capability are significantly important for biological applications. Consequently, development of bio-ceramic materials with drug delivery system will be a significant step in the context of our country.

Objective: The aim of this study is to develop bio-ceramic materials loaded with drug, which can be used as a local drug delivery system in bio-medical field.

Work Progress:

- Preparation of bio-scaffolds: HAp was prepared from waste material following solid state method and by using this HAp, scaffold was prepared.
- Drug loaded matrix: The scaffolds were immersed into antibiotic solution at room temperature. The amount of loaded drug was measured spectrophotometrically and ~50% drug was successfully loaded.
- Drug release study: The scaffolds were dipped into the freshly prepared simulated body fluid. The amount of drug released in the SBF was studied by using UV-Vis spectrophotometer.

Figure:



Figure 1: The prepared scaffolds

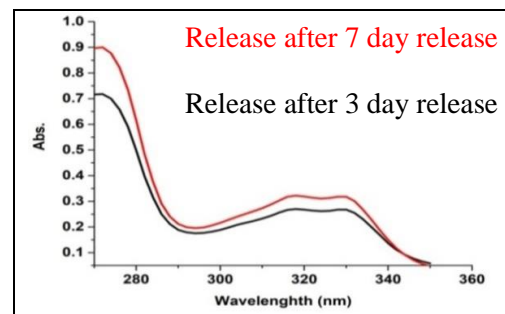


Figure 2: The UV-Vis spectra of the SBF after releasing the drug

Outcomes:

- a) A paper was presented in 15th Annual Conference of Bangladesh Ceramic Society 6-7 April 2017 at BIAM Foundation.
- b) A paper was accepted in International Conference on Chemical Science & Technology and 40th Annual General Meeting of Bangladesh Chemical Society, 24-25 February, 2018 at KUET.

Development of calcium based cementitious materials from bio-resources and its application

Calcium based cementitious materials is an essential material in many different applications, e.g. raw materials in Portland cement industries, whitening agent, metallurgical sector etc. It can also improve the tensile and flexural strength in plastics. Very recently it has been found that different phases of Calcium based cementitious materials showed good bio-compatibilities which opens a new era of biomedical sciences.

Objective: The aim of this study is to develop calcium based cementitious materials from waste bio-resources, which could be used in:

- The cement industries
- Biological sectors
- Ceramic industries

Work Progress:

- Calcium based Cementitious material (1st and 2nd phase) synthesized successfully.
- Characterization of synthesized product was performed through X-ray diffraction (XRD), Fourier transform infrared spectrophotometer (FTIR), Scanning electron microscope (SEM) and Thermogravimetric analysis (TGA) techniques.



Figure 3: The value added cementitious materials from agro-waste

Inorganic Pigment and Chemical Research Division

Synthesis of Cellular Light Weight Roof Casting Insulation Foam using Thermosetting Resin

Insulation foams are used in construction of building in many parts of the world, but it is not very much prevalent in Bangladesh. The common practice of providing insulation to houses here is roof casting. But this task demands a huge amount of time and labor. Usage of insulation foam can be an alternative to this elephant task.

Objective :

- The objective of the study is to synthesis insulation foam by using Urea formaldehyde resin.
- Synthesized foam samples would be applied on brick to observe the insulation phenomena.

Progress :Scale up is going on for quality test.

Removal of heavy metals from wastewater using hydroxyapatite from waste materials and its composites

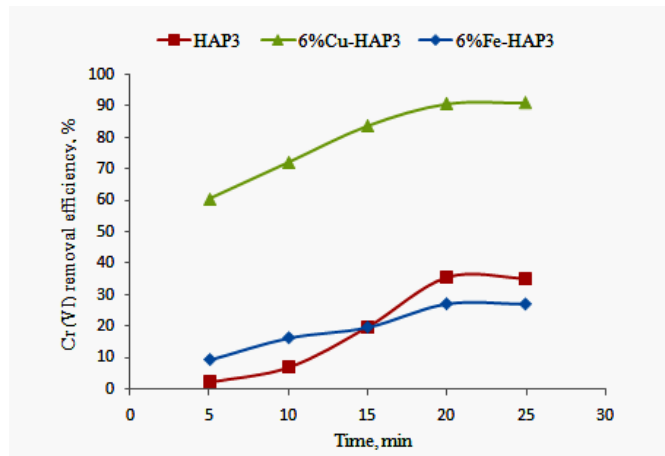
Eggshell will be used to prepare HAP and its composites. These value added products will be applied for removal of heavy metals from waste water. This will be a significant step in waste management system. This research will be an added benefit in two ways- utilization of waste materials to prepare HAP and its composites and also mitigation of heavy metals from waste water.

Objective :

- Aim of this study is to synthesis low cost and potential adsorbents from eggshell for the removal of heavy metals from waste water.

Progress :

- ✓ Hydroxyapatite preparation from waste materials.
- ✓ HAP composites preparation.
- ✓ Characterization of HAP and its composites.
- ✓ Application of HAP and its composites to remove Cadmium (Cd) and Chromium (Cr) from synthetic waste water.



Effect of contact time on thermal treated pure and doped HAP in removal of Cr(VI) from aqueous system

Application of organoclay in removing organic pollutants from aqueous system

Clay minerals find almost innumerable applications and the diversity of its use is still increasing. In addition to applications well-known for a long time, new uses are found and new types of materials are created. Removal of organic pollutants with organoclay would be a significant step in the context of water pollution scenario in Bangladesh.

Objective :

- The objective of this project is to prepare and characterize organoclays to use as sorbents in pollution prevention and environmental remediation.

Progress :

- ✓ Clay modification by CTAB, TX-100 & SDS.
- ✓ Characterization of modified clay.
- ✓ Adsorption of nitrophenol & methylene blue by modified clay at various temperature, time, doses, concentration and pH.

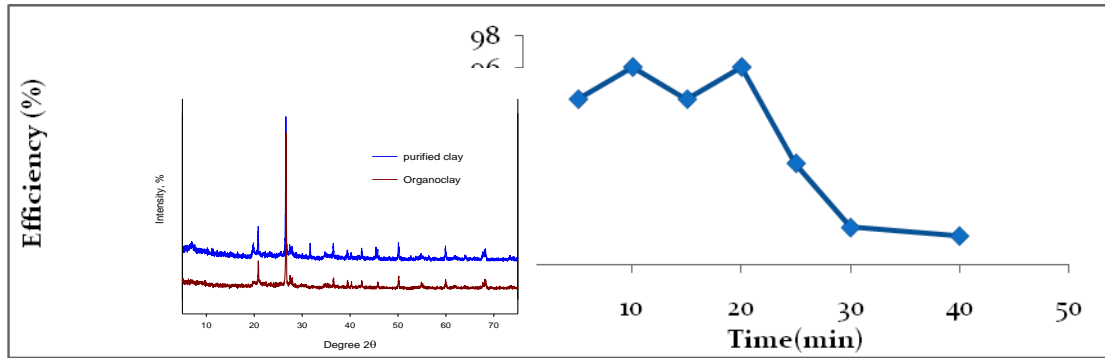


Fig: XRD pattern for purified & organoclay.

Fig: Effect of contact time on SDS modified organoclay in removal of methylene blue.

Refractories and Structural Ceramic Research Division

Production of Light Weight Aggregate using Industrial Waste and Synthetic Organic and Inorganic Polymer

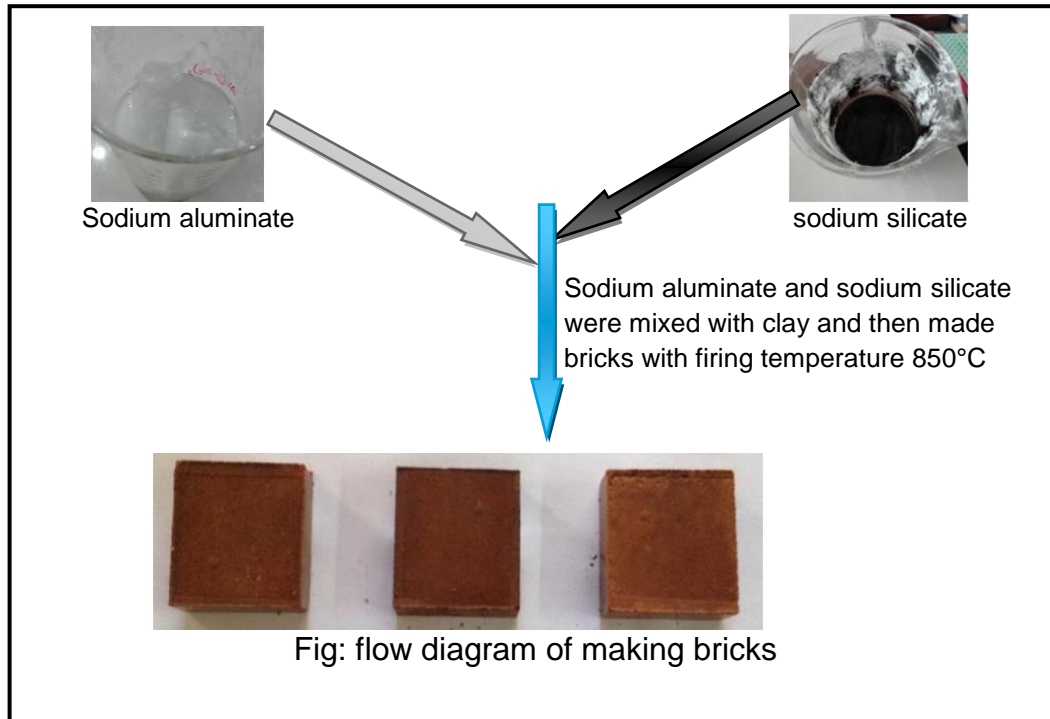
Construction and building materials have great role in the economic dynamics of the society as well as on the environment and surroundings. It has increased resistance against earthquake because of its lightweight materials and has higher thermal insulation properties than conventional concrete. Production of cost-effective environment friendly Lightweight concrete using industrial waste will have a positive impact on our country.

Objective :

- To produce lightweight concrete for both structural and non-structural use.
- To make it cost effective utilize industrial waste materials.

Progress :

- Synthesis of inorganic polymer by using industrial waste has been completed.
- Bricks were made with some different compositions of this synthesized materials developing by searching the optimum compositions.
- Physical and chemical analysis were completed with satisfied results.



Production of Refractory Brick from locally available materials

Now-a-days refractory materials are becoming very much demanding materials in our country. Refractory bricks are one of the largest group among all other refractories used in industry. Refractory bricks are mainly used in linings for furnace, kilns, incinerators and reactors. The final moto of this project is to minimize the costing of the refractory brick production by utilizing the solid wastes from our environment.

Objective:

1. Produce energy saving refractory brick.
2. Enrich local clay by utilizing alumina rich solid wastes to produce refractory brick.

Progress:

- Refractory sample was prepared for testing its refractoriness and other characteristics.



Fig 1: Prepared Refractory Sample(2in. x 2in. x 2in.)

- The refractoriness of local clay has been improved and Fig.2 shows that 40% solid waste is suitable to improve the refractoriness of clay.

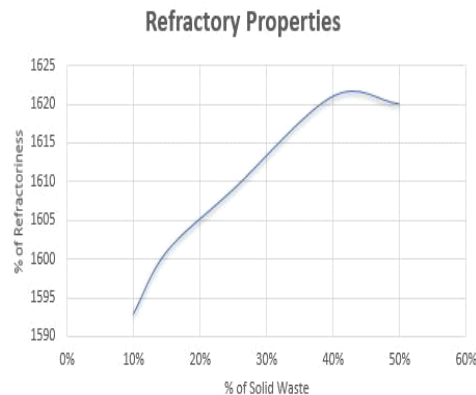


Fig2: Effect of solid waste on therefractoriness of the clay.

Achievements

Research Paper

Rahman M. L., Quddus M.S., Khanam J, Rahman K. M., Bilkis K., Neger A. J. M. N.,
 “Fabrication of Zinc Oxide from Zinc Dust and its characterization”, IOSR journal of Applied Chemistry, Vol. 10 Issue2, Ver. 1, Feb, 2017.

Akhtar,U. S., Tae E. L., Chun Y. S., Yoon* C. S. K, ‘Insights into Decomposition Pathwaysand Fate of Ru(bpy)₃²⁺during Photocatalytic Water Oxidation with S₂O₈²⁻as Sacrificial Electron Acceptor’, ACS catalysis. American chemical society publications, Volume 6, page 8361-8369, 2016.

Akhtar U. S., Zaman M. M., Islam M, Nigar F., Hossain M. K., 'Effect of different types of glasses as fluxing agent on the sintering temperature of bricks', Transactions of Indian Ceramic Society, Taylor & Francis group, Volume 76, issue no. 2, pp. 1-5, June 2017.

Jahan S. K., M. Mollah Y. A., Samina Ahmed and Md. Abu Bin Hasan Susan, 'Copper-doped Hydroxyapatite for Removal of Arsenic (V) from Aqueous System', Journal of Scientific Research, 9 (4), 383-402 (2017).

Begum F., Jahan S. A, Mollah M. Y. A., Rahman M. M., Susan M. A. B. H, 'Stability and Aggregation Kinetics of Silver Nanoparticles in Water in Oil Microemulsions of Cetyltrimethylammonium Bromide and Triton X-100', Journal of Scientific Research, 9 (4), 431-447 (2017).

Khanam J., Rahman M. L., Biswas B, Rahman S., Sharmin S., Ahmed S, Neger T., 'Fabrication of Ferrous Sulfate from Waste like Condensed Milk Containing Can and its Characterization' American Scientific Research Journal for Engineering, Technology and Sciences (ASRJETS), Volume 42, No 1, pp157-165, April 2018.

Islam S.M*, **Akthar. U. S.** and Ahmed. K. S. 'Use of Borosilicate glass as Fluxing Agent to Enhance the Physio-mechanical Properties of Bricks' International Research Journal of Pure & Applied Chemistry, 16(2), 1-9, 2018.

Khanom R., Khan. M. A. A., Gafur A., Akter A., Ahmed S., Shahjahan M., Qadir M. R., 'Synthesis of SnO₂ Nanopowders for Advanced Ceramics and Electronic Sensor Transducer Devices and Characterization and Band Gap', *Nanoscience and Nanometrology*. Vol. 3, No. 1, pp. 12-19, 2017.

Process Accepted

1. Preparation of calcium hydroxyapatite bio-ceramic material from egg shell.
2. Preparation of fluoroapatite from egg shell.
3. Mustafi S. 'Production of cost effective glass-ceramic tiles using rice husk ash'
Ref.No.39.373.037.07.00.00.301.2016/1186, Dated on 01.03.2017

PATENT ACCEPTED

1. Jahan S. A., Mostofa S., Sharmin N., Ahmed S., Kabir, H. 'Preparation of anionic surfactant treated bentonite as adsorbent for water treatment',
3. Yoon* K. B., Hossain M. K., Akhtar U. S. 'Method for low temperature crystallization and interconnection of metal oxide by steam treatment',
Pub. No. WO/2015/119457 international application no. PCT/KR2015/001248
IPC: C01G 23/047 (2006.01)
4. Yeasmin Z, Ahmed S. Sultana S., "Development of a new ketone based hydrophilic resin for high efficient concrete."
5. Yeasmin Z., Rahman M. M., Ahmed S., Rony F. K., 'Development of wollastonite-1A Mineral from waste bio-resources'.

Scientists who Completed/Pursuing PhD/MPhil

Name	Designation	Division	Pursuing Degree	Name of University	Research area
Md. Humayun Kabir	SSO	GRD	PhD	National University, Gwangju, South Korea	Method development and verification for pesticides analysis in agriculture products
Mostaq Ahmed	SO	CRD	PhD	The University of Queensland, St Lucia, Brisbane, Queensland, 4072, Australia	Detecting post-translational modifications in proteins using direct gold-protein affinity interactions
Farah Nigar	SO	GRD		The University of Nottingham	Development of nano bio materials from waste resources

Academic Research Guidance/Supervision

Sl. No.	Title of research	Research category	Name of the Student	Name of academic Institution	Name of the Supervisors
01	Preparation and Characterization of magnetic red oxide from iron containing waste materials	M.S.	Fauzia Jahan	Applied Chemistry and Chemical Engineering, Noakhali University of Science and Technology	Md. Lutfor Rahman, SO
02.	Nano Ceramic Coating	M.S.	Barkat Ullah	Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University	Md. Saiful Quddus, S.O., IGCRT
03.	Production of inorganic polymer using industrial waste materials applicable for building materials	M.S	Md. Hafizur Rahman	Dept. of Chemistry, Jagannath University	Dr. UmmeSarmeen Akhtar, SSO, IGCRT BCSIR
04.	Application of photocatalytic composite biomaterial in treating organic pollutants	M.S.	Md. Maksudur Rahman	Dept. of Applied Chemistry and Chemical Engineering, Dhaka University	Dr. Samina Ahmed PSO and Director, IGCRT Dr.

					ZenefarYeasmin SSO, IGCRT
05.	Development of a bio-ceramic material for the degradation of dyes or textile effluent in aqueous medium.	M.S	Mashrafi Bin Mobarak	Dept. of Applied Chemistry and Chemical Engineering, Dhaka University	Dr. Samina Ahmed PSO and Director, IGCRT Dr. ZenefarYeasmin SSO, IGCRT
06	Impact of aluminum based waste materials on the development of lightweight building blocks.	M.S	Arnob Debnath	Dept. of Chemistry, Jagannath University	Dr. UmmeSarmeen Akhtar, SSO, IGCRT BCSIR
07	Development of energy saving refractory bricks from various industrial wastes.	M.S	Sajal Baidya	Dept. of Chemistry, Jagannath University	Md. Sagirul Islam, SO, IGCRT BCSIR

Major Instrument



Microwave Plasma Atomic Emission Spectrometer (MP-AES)

Suitable for multi-element analysis of metals and non-metals up to sub-ppb level.



Particle Size Analyzer

Used for measuring particle size of different types of sample from 0.01-3500 μ m with specific surface area according to wet dispersion method by using laser diffraction technique.



X-ray Diffractometer

Used to characterize crystal composition, grain size and orientation in powder samples. It can be used to determine molecular or mineralogical composition and phases of the compound.



Atomic Absorption Spectrometer

Excellent performance for flame applications. No problem with the toughest matrices through strong and powerful background correction.

Model: Analytik genaNov AA350

Country of origin: Germany

Procured Year: 2014

Leather Research Institute

Leather Research Institute (LRI) commenced its functioning as a full-fledged monodiscipline research institute with modern facilities from 2000. Prior to its establishment, the Institute began its journey as a division of Dhaka Laboratories, BCSIR with limited facilities. Considering the foreign exchange earning potentials and employment opportunities from the leather sector, the project work of the Institute was started in 1994 and finished in 2000 under the Government's Annual Development Program with a view to strengthen its R&D activities in the field of Leather Science & Technology.

The Institute has six research divisions: Leather Processing, Tanning Material Research, Chemical Research, Animal By-Product Research, Leather Products, and Pilot Plant comprising of modern equipment to carry out research and development program for finding innovation in leather processing technology, developing cost effective chemicals, novel environmental technologies, creative designing of leather products, utilization of slaughter house by-products and tannery wastes.



R&D ACTIVITIES

Development of technology for manufacturing flame retardant leather

Leather is used in a number of public transport situations, for example for upholstery in aero planes, trains and ships, as well as for furniture in public buildings. For these uses there is normally a requirement that the material meet a range of fire-resistance specifications. Flame retardants are chemicals which are added to combustible materials to render them more resistant to ignition.

Objective of the project:

- To investigate the efficacy of a number of flame retardants in order to design a proper processing technique for making flame-retardant leather.

Work progress: Leather has been produced by applying different types of flame retardant chemicals.



Picture: Fire retardant leather

Preparation of acrylic tanning agent for application in leather processing

Polymeric synthetic tanning agents are increasingly used in leather industries due to leather quality, economic and environmental reasons. Acrylic tanning materials have some advantageous properties such as filling the void portions of skin, grain tightness, fastness properties, compatibility with other tanning materials and auxiliaries.

Objective of the project:

- The main objective of this project is to develop acrylic polymeric tanning materials;

- Tanning and retanning characteristics will be evaluated by testing the leather regarding strength, filling, softness, dyeing etc.

Work progress: Synthesis has been carried out with different monomers to prepare tanning agents.

Design and development of safety footwear for fire fighter

Firefighters require protective footwear that can stand up to the host of dangers found on the job: high heat, slippery surfaces, difficult terrain, standing water, punctures, cuts, abrasions and more. In Bangladesh, there is no footwear manufacturer is available for firefighting people. That's why; Bangladesh is compelled to import that type of shoes for fire fighters. Availability of safety footwear will minimize the importation and save the foreign currency. Moreover, the organizations who are engaged in fire fighting will be able to procure their shoes for their professional personnel locally at reduced price too.

Objectives of the project:

- To design and fabricate shoes for fire-fighting people

Work progress: The work of the R&D project is completed.



Picture: Toe-Cap for Safety footwear



Picture: Shoe-last for safety footwear

Design and development of combined shoe polishing and sole cleaning machine

The machine which is going to be designed called as “Combined Shoe Polishing and Shoe Sole Cleaning Machine”

The machine is important for sophisticated Laboratories, as these laboratories have highly précised instruments, sensor etc. so the air inside should be very clean. Corporate offices also need a neat and clean environment to satisfy their customers.

Objectives of this project:

- To provide an apparatus for shining shoes which overcomes the problems encountered in the conventional art;
- To combine the operation like cleaning and polishing at one place.



Picture: Shoe sole cleaning with polishing machine

Work progress: A prototype of the machine has been developed.

Production of Counter Stiffener from the wastes of Leather products industries

Reinforcement is very important material for footwear and leather products. It stiffens the back part of the whole shoe. A heel cup formed from a flexible material is located under the heel region of an upper portion of an article of footwear. Lateral and medial counters extend upward from the heel cup on the lateral and medial sides, with the medial counter having a height less than that of the lateral counter, and with a rear edge of the heel cup being lower than the lateral and medial counters. This project aimed to develop at least one commercially viable recycling route for finished leather, thereby lessening the environmental impact of the footwear industry and improving its competitive edge by reducing waste disposal costs. The use of products containing waste leather would be demonstrated in applications in footwear and other industries.

Objectives

- To utilize leather dust and waste leather;
- To develop reinforcement for footwear & leather goods from waste leather.

Work Progress:

Leather board has been made from the waste of leather products industries and applied in the footwear fabrication.



Picture: Leather board from waste leather

ACHIEVEMENT

Research Papers

1. A paper published on “Ammonia – Reduced Deliming using Glycolic Acid and EDTA and its Effect on Tannery Effluent and Quality of Leather by Murshid Jaman Chowdhury, Md. Tushar Uddin, Md. Abdur Razzaq, Al-Mizan, and Ariful Hai Quadery in JALCA, VOL. 113, 2018

Process accepted

Development of ammonia free deliming agent for leather processing
by Murshid Jaman Chowdhury, Md. Tushar Uddin, Md. Abdur Razzaq, Al-Mizan,
and Ariful Hai Quadery

Participation in Foreign Training

Dr. Md. Tushar Uddin, SSO, Murshid Jaman Chowdhury, SO and Al-Mizan, SO
participated in a training program at UK on Test Equipment from 26 September
to 05 October, 2017 arranged by Shoe & Allied Trade Research Association.

Scientists pursuing M.S/M. Phill/ Ph. D in home or abroad

1. Kanish Fatama, SO, of Footwear Section pursuing M.Sc degree in Environmental Science from Jahangirnagar University, Bangladesh.

Institute of Mining, Mineralogy and Metallurgy

Institute of Mining, Mineralogy and Metallurgy (IMMM) is one of the leading full-fledged multidisciplinary operating units of Bangladesh Council of Scientific and Industrial Research (BCSIR). It was established to grow up sustainable economy of Bangladesh by utilizing natural resources through the R&D activities on Mining, Mineralogy and Metallurgy fields.

Honorable Prime Minister of the Peoples Republic of Bangladesh Sheikh Hasina inaugurated this institute on 22nd January, 2012. The honorable Prime Minister expressed her satisfaction about R&D activities of IMMM and inspired the personnel to take modern instrument based applied research project to develop science and technology innovation system of Bangladesh. She urged the scientists to expose their research findings to the nation and build up technological innovation using natural resources so that Bangladesh could reach a top level economy in the world.

IMMM is the one and only research organization of Bangladesh conducting research on mining, mineralogy and metallurgy sectors of Bangladesh. The following research, development and innovation competences exist within the unit (i) Mining Division (ii) Mineralogy Division and (iii) Metallurgy Division.



R&D Activities:

Development of Pavement Tiles using different Industrial Wastes (stone dust/rock dust, fly ash, bagasse ash) with Portland cement

In Bangladesh adequate amounts of agricultural and industrial waste produces from different source and disposal of these wastes cause enormous environmental problems. This research is to develop pavement tiles which made from Portland cement and hard rock particles (3-5 mm in size) with mixing fine particles of various types wastes such as rock dust/stone dust, fly ash, bagasse ash.

Objectives:

- Preparation of pavement tiles by utilizing Hard Rock particles (3-5mm).
- Preparation of high strength pavement tiles by utilizing industrial wastes.

Work Progress:

- Develop high strength pavement tiles.
- Addition of different sizes of rock dust in concrete mix improved the mechanical properties compare with other wastes, however, further research should be taken.
- A process of pavement tiles will be submitted to BCSIR.
- A conference paper presented at 15th Annual Conference of Bangladesh Ceramic Society.



Fig: Pavement tiles using different wastes.

Utilization of rice husk ash as soil amendments and its effects on plant growth

Rice husk ash is one of the most widely available agricultural wastes in northern regions of Bangladesh. Rice husk ash is generated during parboiling of rice in rice mills. Removal of these materials creates disposal problem due to less commercial interest and environmental hazards. Preliminary investigation suggests that rice husk ash contains 80-90% silica and other plant nutrient materials which make it able to use as soil amendments.

Objectives:

- To use rice husk ash as soil amendments.
- To encourage the utilization of agro industry based waste materials as low cost fertilizers.
- To reduce environmental pollution due to rice husk ash.
- To solve the disposal problem due to rice husk ash in rice-based industrial regions.

Progress achieved:

- Background analysis of soil samples and rice husk ash was done.
- Pot experiment with 4 doses of rice husk ash was conducted with two varieties of rice.
- Laboratory work of the project is going on.



Figure: Pot Experiment

Industrial process development for mineral separation from Padma and Tista River Basin

The River Padma and Tista are mainly sand bedded river and the quantity of sediments carried by the river is tremendous and the sediments contain large quantity of sandy materials, which are generally laid down in the beds of the river, forming sand bars. The sand bars are prospective for valuable heavy minerals like zircon, rutile, garnet, ilmenite, magnetite and monazite etc.

Objectives:

- Mineralogical and geochemical analysis of the river sand Padma and Tista.
- Development of a flow sheet for processing the concentrate into its component minerals.

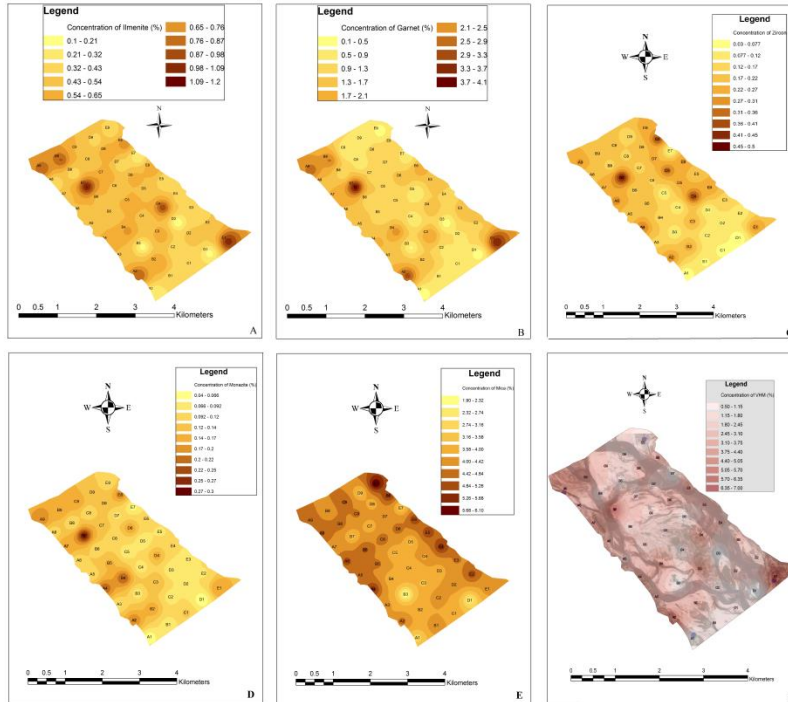


Figure: Concentration maps showing the distribution of various VHM with depth for the 45 sample sites on the Rajpur mid-channel sand bar: (A) Ilmenite; (B) Garnet; (C) Zircon; (D) Monazite; (E) Mica; and (F) total VHM.

Work Progress:

Surface and borehole sampling of sediments along a ~80 km section (sediments from the surface to 15 m depth) of the lower Tista river in northwestern Bangladesh indicated that the river sands offer significant potential as a heavy mineral (HM) resource. The percentage of the more valuable HMs (ilmenite, rutile, zircon, monazite, garnet) was 2.47% (average) in the samples. Detailed borehole sampling and resource mapping of a large, mid channel sand bar showed that placer-style HM accumulations occur significantly at upstream and along the margins of the bar (Fig). A preliminary techno-economic evaluation of setting up a conceptual 200 tph mining and processing plant based on sands of Rajpur bar of Tista river has done. The flowsheets, plant layouts and the plant design have been developed on the basis of existing mineral mining and mineral processing plant.

The project financial summary shows that the capital cost of the project is 11.12 million USD and operating cost is 2.06 million USD per annum. The internal rate of return (IRR) based on the first 25 years of operation only (with no terminal value) is 20% and the projected payback period is approximately 7 years after operations commence which is prospective.

Recovery of precious metals (i.e. gold) from electronic waste

There have been generated a lot of electronic waste (e-waste) from our day to day use discarded electronic devices such as mobile phone, computers, TVs, printers etc. For environmental reasons proper management of these e-wastes is essential. We are trying to recover valuable metals from e-waste to reuse the resource and save the environment from pollution by e-waste.

Objectives:

- To recover valuable metals
- Protect environment from pollution
- Recycle of e-waste

Work progress:

- Different e-waste (mobile phone, computers) has been collected and chopped in small pieces.
- Laboratory work of the project is going on.



Figure: Mobile phone PCB as e-waste



Figure: Chopped PCBs from waste mobile phone

Preparation of zeolite from industrial wastes

Rice husk is an organosilicate waste co-product of the rice industry. When burnt it deposits about 20% of ash and which is composed of 84% silica (SiO_2). The ash has no economic value, usually dumped in the open space and poses a significant waste disposal problem. Reactivity of organosilicon compound is high and could be produced desired product inexpensively. Common formula of zeolite is $\text{Na}_2\text{Al}_2\text{Si}_3\text{O}_{10} \cdot 2\text{H}_2\text{O}$. We have prepared good quality of zeolite from the waste of rice mill ash.

Objectives:

- The main objective of the project is to provide a process for the preparation of zeolite.
- Another objective of this project is to clarification of waste water and purification of drinking water.



Fig: Prepared Zeolite

Progress:

A process for the preparation of zeolite from industrial wastes has been submitted to BCSIR for verification.

Assessment of valuable minerals and rocks of Quaternary Gravel Deposits in and around Joypurhat, Bangladesh for industrial application

Production and business of gemstone from river bed gravel play significant role in economy of many developed countries including India. The proposed study area Joypurhat is located beside the present Little Jamuna river. Quaternary gravel deposits in Little Jamuna river basin are mainly different graded metamorphic rocks like red, pink, purple, maroon and golden quartzite, smoky quartz, milky quartz, quartzose sandstone, various colored schist and gneiss, marble, graphite, talc etc. and granitic igneous rocks.

Objectives:

- Exploration & characterization of physical, chemical, mineralogical and gemological properties of the Quaternary gravel bed deposit in the study area.
- Determine and gradation of quality to produce precious to semi-precious stones.

Progress Achieved:

- An extensive field work has been conducted by 8 boreholes to explore & sampling the gravels deposits.
- Based on physical, chemical & gemological properties & purpose of economic use, gravels have been categorized into three grades i.e., Grade-A for construction use, grade B for tumbling stone & grade C for semi-precious gem stone respectively.
- Tumbling & semi-precious gem stones have been made from raw gravels through cutting & polishing.



Fig: Photograph Showing, (a) Major gravel types of the study area. (b) Tumbling of some gravels may used for various decorative purpose and (c) semi-precious gems produced from gravels found the study area.

Achievements:

Research Papers

Sakib T. U. and Sultana, M. S., "Assessment of Heavy Metals Contamination of Agricultural Field Around Brick Kilns in Joypurhat District, Bangladesh". *International Journal of Science and Engineering Investigations*. 6(70), 98-105. 2017.

Biswas P. K., Uddin N, Alam S, Sakib T. U, Sultana S, and Ahmed, T., "Evaluation of Heavy Metal Pollution Indices in Irrigation and Drinking Water Systems of Barapukuria Coal Mine Area, Bangladesh", *American Journal of Water Resources*. 5(5), 146-151. 2017.

Ahmed A.N., Khan A.A., Saha M.S., and Sultana S., "Characterization of Coal Spoil Recovered from Coal Mine Drainage Water" *International Journal of Geoscience and Environment Protection*, (5), 227-236, 2017.

Sultana, M. S. Zaman, M N. Rahman, M. A. Biswas, P. K. Nandy. P.K. 'Mineralogical and Physical Characterization of Clay of Sitakunda Anticline: Used for Ceramic Industries. *Journal of Minerals and Materials Characterization and Engineering*, 2018, 6, 333-344.

Conference abstract

Sakib T. U and Hoque, S., "An environmentally friendly approach for reclamation of Lead and Cadmium contaminated soil using fresh organic matter", Symposium on Environmental Chemistry for Securing Water Quality, *Bangladesh Journal of Scientific and Industrial Research*, 52(special issue), 19, 2017.

Khan A. A., Sakib T. U, Ahmed A. N and Sultana, S., "Environmental aspects of coal ash pond water: Surface and ground water contamination", Symposium on Environmental Chemistry for Securing Water Quality, *Bangladesh Journal of Scientific and Industrial Research*, 52(Special issue), 20, 2017.

Sultana, M. S., Ahmed, A.N., Zaman, M N., Rahman, M. A.,' "Utilization of Hard Rock Dust in Ceramic Glaze Formulation" Presented at 4th *International Conference on structure, processing, properties of materials* held on 1-3 March 2018, BUET, Dhaka.

Hasan, M.A.S.M., Hossain, I and Rahman, M. A., "Petrogenetic Characteristics of Detrital Fe-Ti Oxide Minerals of Brahmaputra River Sediments in Bangladesh" Presented at International Conference on Recent Advances in Mathematical and Physical Sciences held on 27-29 January 2018, Jahangirnagar University. Dhaka 1342. Bangladesh.

Jahan, H., Hossain, M.S., Hossain, M.S and Rahman, M. A., "Crystalline Basement Rocks from drillhole GDH-62 from Dighipara, Dinajpur, Northwest Bangladesh: Petrologic and geochemical constraints" Presented at International Conference on Recent Advances in Mathematical and Physical Sciences held on 27-29 January 2018, Jahangirnagar University. Dhaka 1342. Bangladesh

Process accepted

Islam, M. K., Khan, M. A. R., Ahmed, T., Ahmed, A. N., Gafur. M. A., "A process for the production of lead (Pb) free tin (Sn) based solder for electronic applications" Accepted by the office, Member Development, BCSIR, Dhaka. Ref No: 39.02.0000.043.020.17/815, Date: 01.08.2017

Patent accepted

Sultana, M. S. Ahmed, A.N. Zaman, M N. Rahman, M. A." A Process for formulation of ceramic glaze from natural resources. Accepted by Department of Patents, Design and Trademarks, Government of Bangladesh. Patent No. 1005993 Date. 20.05.2018. Reference No. 39.02.0000.043.37.129.18/1044 Date.01.07.2018

Participation in Foreign Training

- Md Khairul Islam, Engineer, IMMM, BCSIR, Joypurhat attended Professional development training in Materials Engineering (Endeavour Executive Fellowship-2018) in CSIRO, Melbourne, Australia from 01.02.2018 to 30.06.2018.
- Pradip Kumar Biswas, SSO, IMMM, BCSIR, Joypurhat attended training on Mineral Processing in CSIRO, Melbourne, Australia from 02.02.2018 to 02.05.2018.

Scientists pursuing M.S/ M.Phil/ Ph.D Courses in home and abroad

- Sharmin Sultana, SSO, IMMM, BCSIR, Joypurhat pursuing Ph.D course under supervision of Dr. Shahid Akhtar Hossain, Professor, Dept. of Soil, Water and Environment, University of Dhaka, entitled thesis "Suitability of treated effluent water for irrigation in crop production" from the session 2016-2017.

Academic Research Guidance/Supervision

S.N	Title of Research	Research Category	Name of student	Name of academic Institution	Name of supervisors in BCSIR
1.	Economic evaluation of mineral sands of mid channel bar of the Padhma river opposite to Mothihar thana, Rajshahi City Corporation.	M.Sc	Sohag Ali	University of Rajshahi	Dr. Mohammad Nazim Zaman, PSO, IMMM, BCSIR, Joypurhat
2.	Economic evaluation of mineral sands of lateral channel bar of the Padhma river from Kashiadanga to Haripur, SouthWest of Rajshahi City Corporation.	M.Sc	Md. Abujar Gaffari	University of Rajshahi	Dr. Mohammad Nazim Zaman, PSO, IMMM, BCSIR, Joypurhat
3.	Peat characterization of Baghia Chanda Bell peat deposit, Madaripur, Bangladesh	B.Sc	Bristi Khatun	Jessore University of Science and Technology.	Pradip Kumar Biswas, SSO, IMMM, BCSIR, Joypurhat,
4.	Peat characterization of Hakaluki Haor peat deposit, Moulvibazar, Bangladesh	B.Sc	Probir Kumar Sarkar	Jessore University of Science and Technology.	Md. Shah Alam, SO, IMMM, BCSIR, Joypurhat
5.	Heavy Metal & Trace Element Contamination in Surficial Sediments and mine wastewater around of Madhyapara Hard Rock Mine, North-West, Bangladesh"	B.Sc	Hossain Al Tanjil	Jessore University of Science and Technology.	Pradip Kumar Biswas, SSO, IMMM, BCSIR, Joypurhat,

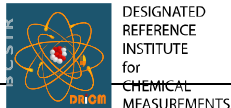
Photographs



Celebration of Birth anniversary-2018 of Father of nation, Banghubondhu Sheikh Mujibur Rahman, at IMMM



Meeting with stake holder held at IMMM, Joypurhat 2018



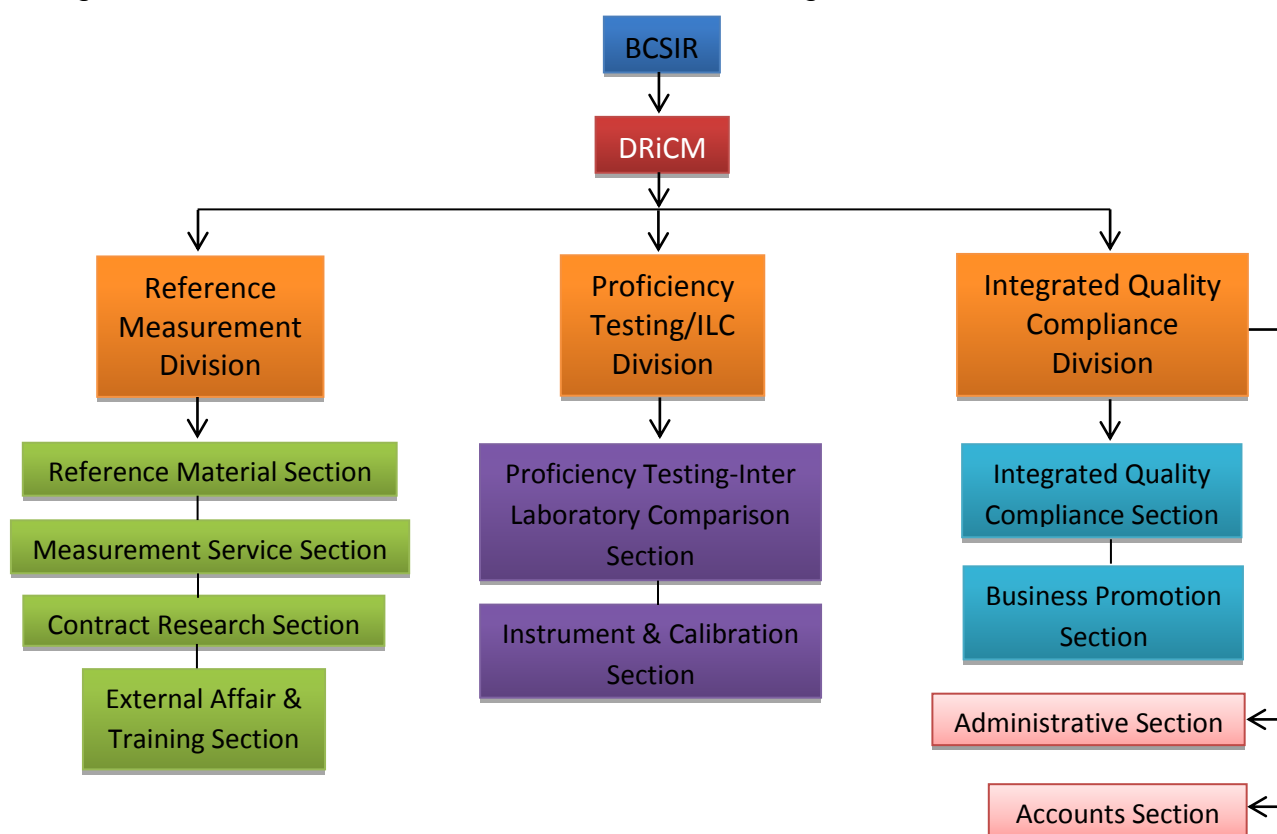
Designated Reference Institute for Chemical Measurements (DRiCM)

Designated Reference Institute for Chemical Measurements (DRiCM) is the first and only reference laboratory for chemical measurements in Bangladesh. DRiCM is committed to develop and deliver values to its clients with a view to satisfying their needs through implementing and practicing the Integrated Quality Management System (IQMS), meeting the requirements stated in the International Standards: ISO 9001, [50/IEC 17025, 150/IEC 17024, 150/IEC Guide 43, ISO Guide 34 as well as in the Rules and Regulations of Government of Bangladesh and BCSIR and also fulfilling the criteria defined by the accreditation and/ or the recognizing body(ies). DRiCM became the Burea International des Poids et Mesures (BIPM) member which is the world's highest international organization for measuring science in 10 October, 2012. As a result, the organization has added more than 273 national and international reference organizations through the mutual cooperation of the highest network. On 7th May, 2013, the Regional Association of more than chemical metrology related 40 countries elected DRiCM as a member of the Asia Pacific Metrology Program (APMP) by 100% member state voting and become the symbol of Bangladesh's national pride. National Quality Policy for Goods and Services-2015 nominate the DRiCM as Designated Institute (DI) for measurements science/metrology. For outstanding contribution in developing chemical metrology infrastructure in Bangladesh, Dr. Mala Khan awarded APMP DEN Award-2015 from the apex body for metrology in Asia Pacific region APMP.



Front view of Designated Reference Institute for Chemical Measurements

Organizational structure with their defined activities is given below:



R& D Activities

Environment friendly clay coagulant aid for Industrial Effluent Treatment Plant

The rapid growth of the population around the world are associated with using huge quantities of water in different activities including the industrial activities. Wastewater treatment is the process of taking wastewater and making it suitable for discharging back into environment. Coagulation is an essential process in the treatment of both surface water and industrial wastewater. Chemical coagulants like Polyaluminium chloride (PAC) and alum ($AlCl_3$) add impurities such as epichloride, which are carcinogenic. Besides that aluminum is a major poisoning factor in encephalopathy dialysis and contributes to Alzheimer disease. Clay minerals have been used as a coagulant aid in removal of toxic compounds, heavy metals and color removal. These clay minerals have high cationic exchangeable capacity. Those exist as a natural substance which are used for water treatment. Besides its cost is low and easily available. Many countries in the world have gotten fruitful result in removing pollutants from wastewater by using natural coagulants. But this type of treatment procedure of wastewater is not being used in Bangladesh. This is the for the first time in Bangladesh that clay has been used as coagulant for wastewater treatment.

Objectives

- To develop clay based coagulant aid for ETP.
- To characterize developed coagulant.

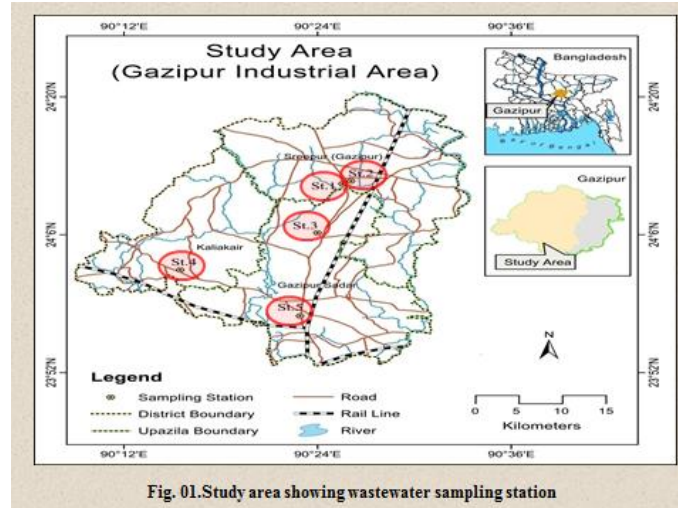


Table: Correlation analysis for clay coagulant PKS- 01

	pH	Turbidity	COD	Cd	Cr	Ni	Pb	Al	Fe	Cr	SO ₄ ²⁻
pH	1										
Turbidity	0.265	1									
COD	0.933	0.205	1								
Cd	0.859	-0.159	0.707	1							
Cr	-0.015	0.057	0.336	-0.337	1						
Ni	0.885*	-0.121	0.740	0.998**	-0.309	1					
Pb	b	b	b	b	b	b	b				
Al	0.563	0.705	0.593	0.194	0.385	0.225	b	1			
Fe	0.799	-0.045	0.933*	0.652	0.491	0.674	b	0.544	1		
Cr	0.516	0.433	0.524	0.228	0.040	0.272	b	0.099	0.235	1	
SO₄²⁻	0.917*	0.582	0.779	0.696	-0.172	0.723	b	0.633	0.535	0.612	1

* Correlation is significant at the 0.05 level (2- tailed)

** Correlation is significant at the 0.05 level (2- tailed)

b. Cannot be computed because at least one of the variable is constant

Work Progress

- ❖ Through the use of clay coagulants, considerable amount of turbidity, pH, COD and heavy metal have been removed. The result is so far achieved is satisfactory.
- ❖ Currently we are getting better result by using local soil than foreign soil.

Method development and validation for the detection of acrylamide in potato chips

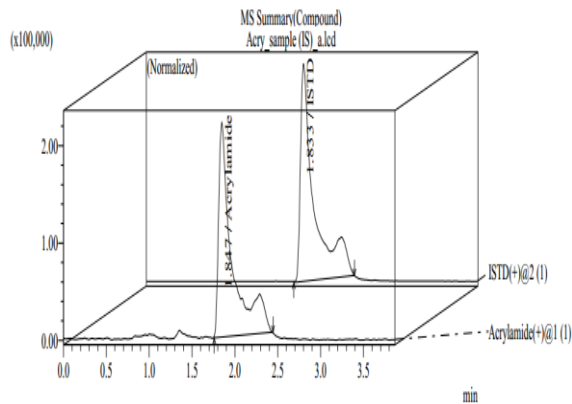
In order to obtain quality food products it is necessary to maintain nutrients like minerals, carbohydrates, fats, proteins, vitamins, enzymes etc. It is obvious that, nutrients may be destroyed or lost when foods are fried under high temperature because of their sensitivity to heat. Generally, fried foods served in restaurants or packed by food industry are often cooked in hydrogenated oils to give satisfying taste and crunch to consumer. But, fried foods may influence risk of several diseases like obesity, high blood pressure, high cholesterol and type-2 diabetes, raising bad cholesterol (LDL) levels, lowering good cholesterol (HDL) levels and chance of having heart disease. Recently, another concern with fried food is acrylamide, a chemical that forms in foods when cooked at high temperatures, such as fried and baked foods. Acrylamide (C_3H_5NO ; 2-propenamide), is a colorless, non-volatile crystalline solid, soluble in water and has a molecular weight of 71.08 kDa. When food is cooked at very high heat, the main pathway for the formation of acrylamide in foods is through Millard Reaction, where reducing sugar such as glucose, fructose and amino acid asparagine are believed to be the major precursors. As acrylamide is formed naturally in food it is believed to be metabolized to glycidamide and has potential mutagenic and neurotoxic effect.

Objectives

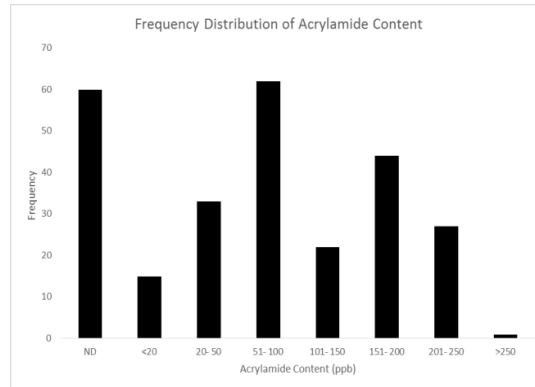
- To develop a validate LC-MS/MS method for the determination of acrylamide in potato chips and other locally available fried foods.

Work Progress

- ❖ A simple, precise and accurate method was developed and validated for quantification of Acrylamide in potato chips as well as other fried food matrix.
- ❖ Besides that, analytical facility for acrylamide quantification is given to many potato chips producing industry.



Chromatogram of acrylamide in sample



Acrylamide content of different food in Bangladesh

Production of Bio-ethanol from rice straw and jackfruit waste

Rice is our staple food of Bangladesh. Rice straw remains in the field after collecting paddy. A small amount of rice straw is used as cattle food and fuel. Most of this rice straw remains unused. On the other hand, jackfruit is the national fruit of Bangladesh. Every year a huge number of jackfruit is consumed by the people of Bangladesh. After consuming jackfruits, wastes are dumped. It has no commercial application in our country. This rice straw and jackfruit waste can be used as the raw materials for production of ethanol. That will fulfill our required ethanol demand. Ethanol is used extensively as a solvent in the manufacture of varnishes and perfumes; as a preservative for biological specimens; in the preparation of essences and flavorings; in many medicines and drugs; as a disinfectant and in tinctures (e.g., tincture of iodine); and as a fuel and gasoline additive. Only one industry in Bangladesh produces Ethanol but this production does not fulfill the demand. For that a huge amount of ethanol is needed to import. And that's why we lose our currency in every year.

Objectives

- To make effective use of rice straw and jackfruits wastes to produce Bio-ethanol.
- To develop the easiest method of Bio-ethanol production from rice straw and jackfruit wastes that can be used in industrial purpose.
- To compare ethanol production between Acid/ Base hydrolysis and enzymatic hydrolysis process.

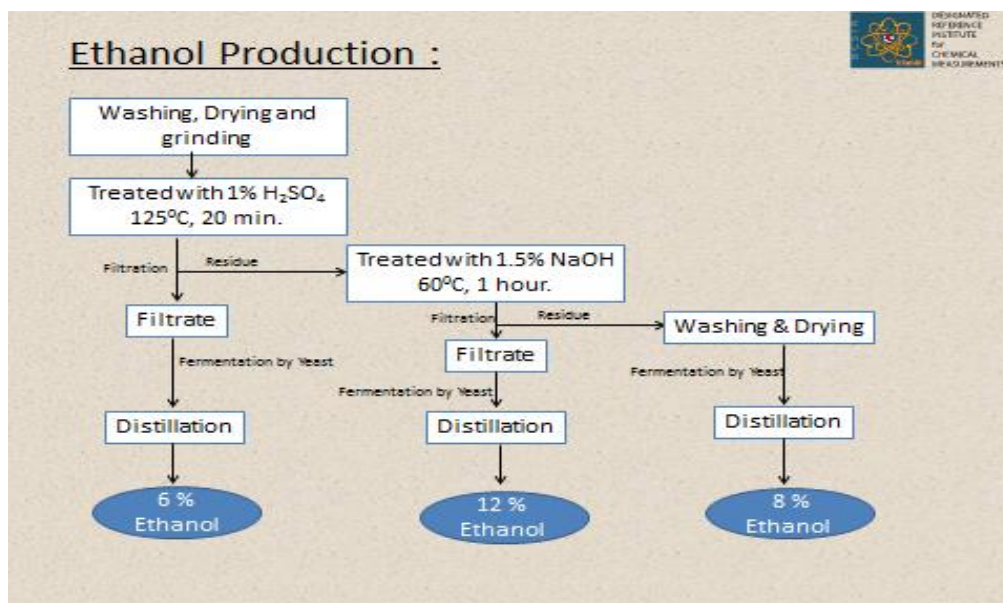


Figure: Schematic Diagram of Ethanol Production from Jackfruit Waste

Work Progress

- ❖ Process for extraction ethanol from rice straw and jack fruit has been developed.
- ❖ It has been determined that from waste material, it is possible to produce 6-12 percent ethanol.
- ❖ A method has been developed for the determination of ethanol using HPLC- RI

Isolation and Identification of Cr(VI) reducing bacteria from tannery effluent.

Heavy metal pollution of water is a major environmental problem all over the modern world. Among heavy metals chromium is the major pollutant of the leather tanning industry and is toxic to plants and animals around the environment. The chrome tanning process results in toxic metals, especially chromium (VI) passing with waste water directly or indirectly into natural water bodies, mostly without proper treatment, poses a major threat to the environment. Among the different forms of chromium, the hexavalent chromium Cr⁶⁺ is the most toxic and carcinogenic due to its high solubility in water, rapid permeability through biological membranes and subsequent interactions with intracellular proteins and nucleic acids. They are significantly toxic even in small amounts and can cause diseases in humans and animals as they cause irreversible changes in the body, especially in the Central Nervous System. Microorganisms play a

significant and vital role in bioremediation of heavy metal contaminated soil and wastewater. Indigenous bacteria appear well suited for Cr (VI) transformation in tannery effluent and may accumulate chromium within its cells by adaptation to the high concentration of the metal. Very stable final chromium forms can be achieved as a result of microbial activity, with minimal risk of re-release of Cr (VI).

Objectives

- To isolate the microbes from tannery effluent that is capable to reduce Cr (VI) to Cr III
- To assess the chromium reduction capacity at different concentration of Cr (VI).
- To investigate the kinetics of chromium reduction by indigenous bacteria

Work Progress

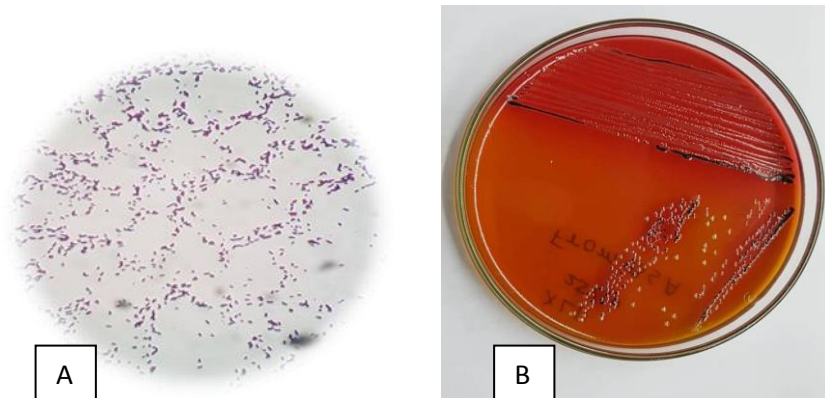
- ❖ Isolation and biochemical identification of microbes which is capable to reduce Cr (VI) to Cr III from tannery effluent has been done
- ❖ We are going to assess the chromium reduction capacity at different concentration of Cr (VI) and kinetics of chromium reduction

Identification and characterization of quorum-sensing signaling molecules of enteric bacteria.

The major role of quorum sensing molecule in case of pathogenesis is that it helps the secreting bacterial species to form quorum with same species or other species. When quorum is formed which is known as biofilm in scientific world, the pathogenesis rate of the respective bacteria increases exponentially. So, if an anti-quorum sensing molecule can be designed to prevent this quorum formation it will definitely reduce the pathogenesis rate of the bacteria. Since, the enteric bacteria contains over 60% of the total number of serovars and 99% of the serovars are capable of infecting cold and warm blooded animals as well as humans. So, research on enteric microbes is very important because wide use of antibiotics and lack of its rational practice nowadays drug resistance has been shown among microorganisms. So, determining the structure and designing a mimicking agent of quorum sensing molecule will provide pharmaceutical industry with new aspect of antimicrobial drugs.

Objectives

- To identify specific *N-acyl homoserine lactones* (AHL) as quorum sensing molecule.
- To characterize of quorum signaling activity through anti-quorum sensing properties.



Progress: Figure: A. Gram Positive staining and B. XLD selective media culture of *Salmonella sp.*

Work Progress

- ❖ For identification and characterization of QS molecule in *Salmonella sp.*, gram staining, biochemical identification of microbes, bacterial growth curve, antibiotic screening, Biofilm production parameter already checked.
- ❖ Now we are trying to isolate QS from microorganisms and find out anti QS molecule from another microbes or plant extract.

Achievements

Research papers

A. Khaleque, M. Afroze, M. Khan, M.S Hossain, M.M. Islam and M. Nurunnabi, Upgrading Pyrolysis Oil for Alternative Sources of Petroleum, National Journal of BAUEL Journal, 01 (02), 2018.

Md. Sazedul Islam, PapiHaque, Taslim U. Rashid, M.NaruzzamanKhan, Abul K. Mollik, M.Nazrul I. Khan, Mala Khan, Mohammed MizanurRahman, Core-Shell drug carrier from conjugated Chitosan obtained from prawn shell for targeted doxorubicin Delivery Mater Sci: Mater Med 28:55, 2017.

Md. Galal Uddin, Md. Moniruzzaman and Mala Khan, Evaluation of Groundwater Quality Using CCME Water Quality Index in the Rooppur Nuclear Power Plant Area, Ishwardi, Pabna, Bangladesh, American Journal of Environmental Protection., 5(2), 33-43, 2017.

Shanta Biswas, Taslim U. Rashid, Abul K. Mallik, Md. Minhajul Islam, M. Nuruzzaman Khan, Papia Haque, Mala Khan, and Mohammed Mizanur Rahman, Facile Preparation of Biocomposite from Prawn Shell Derived Chitosan and Kaolinite-Rich Locally Available Clay, *International Journal of Polymer Science*, 2017, 8 pages, 2017.

M Moniruzzaman, MA Rahman, S Aktar and M Khan, Equilibrium and Kinetic Parameters Determination of Cr (VI) Adsorption by Hogla Leaves (*Typha elephantina* Roxb.), *International Journal of Waste Resources*, 7 (4), 6 pages, 2017.

Md. Shameem Hossain, A. Abedeen, Md. Rezaul Karim, Md. Moniruzzaman and Md. Juwel Hosen, Catalytic Pyrolysis of Waste Tires: the influence of ZSM-catalyst/tire ratio on Product, *Iranian Journal of Energy and Environment* 8(3); 189-193, 2017.

M. Ahasanur Rabbi, Ayesha Akhter, Mala Khan, H. Jahan Kadri, Bijoy Maitra and M. Hamida Khatun, Chemical composition and antifungal activity of sugarcane bagasse and banana stem based wood vinegar, *International Journal of Chemical, Biological and Physical Sciences*, 7 (4), 898-904, 2017

Md. Abdul Mottalib, Sobug Roy, Md. Shakil Ahmed, Mala Khan and A. N. M. Al-Razee, Comparative study of water quality of Buriganga and Balu river, Dhaka, Bangladesh, *International Journal of Current Research*, 9 (10), 59132-59137, 2017.

Md. Badrul Islam, Md. Md Moniruzzaman, Sarkar, Md Redwanur Rahman, Mala Khan, Mirola Afroze, Md Abu Hasan, Md Juwel Hosen and MAA Shofi Uddin Sarkar, Fatty Acid Profile of Freshwater Crab (*Paratelphusa lamellifrons*) from Padma River of Rajshahi City, Bangladesh, *National Journal of Nutrition & Food Sciences*, 7 (6), 4 pages, 2017.

Md. Badrul Islam, Md. Moniruzzaman Sarker, Md. Redwanur Rahman, Mala Khan, Md. Juwel Hosen, Md. Abu Hasan, M. A. A. Shofi Uddin Sarkar and Mirola Afroze, Comparison on fatty acid profile in the different body parts of freshwater crab (*Paratelphusa lamellifrons*), *International Journal of Biosciences*, 11 (6): 186-191, 2017.

Md. Galal Uddin, Md. Moniruzzaman, Mohammad Abdul Quaderb, Md. Abu Hasan, Spatial variability in the distribution of trace metals in groundwater around the rooppur nuclear power plant in Ishwardi, Bangladesh, *Groundwater for Sustainable Development*, 7, 220-231, 2018.

Confirming traceability of DRiCM with BIPM, APMP through Participating in Proficiency Testing (PT) Programme

SI No	Title	Organizer/ Mentoring Institute
01	Low-Polarity Analyte in high fat food: Benzo[a]pyrene in Olive	Organizer-CCQM-BIPM Mentoring Institute-National Metrology Institute, China
02	42nd Official OPCW Proficiency Test	Organization for the Prohibition of Chemical Weapons (OPCW)
03	Cadmium (Cd) in milk powder	Organizer-Asia Pacific Metrology Programme (APMP) Mentoring Institute- National Metrology Institute, China

Calibration Service

Seventy four calibration services has been given on Mass, Balance, Volumetric Glass wear, Electric Incubator and Electric Oven

Method Validation-Following two method validation are completed

- Acrylamide in potato chips
- Fosfomycin in Oral-3 powder

Contract Research

SI No.	Research Title	Institute	Progress
01	Omega-3 production from local strain of Micro Algae	Algasol Bangladesh Ltd.	Running

Collaborative Research

SI No.	Research Title	Institute	Progress
01	Low temperature plasma and its environmental and biological application	Department of physical science, IUB	Complete
02	Determination of trans fatty acids in fast food of Dhaka city	Department of Chemistyr, Jagannath University	Running
03	Analysis of hydrocarbon oil produced by degradation of waste plastics		Running

Research Fellow

SI No.	Name	Fellowship Title	Research Conducted by fellow
01	Monika Mahmud	Prof. Abdullah Al Muti Sharfuddin Memorial Fellow	Incorporation of Activated carbon in Environment friendly clay coagulant Aid for industrial ETP plant
02	Md. Ariful Islam	Prof. Abdullah Al Muti Sharfuddin Memorial Fellow	Chromic/ Chromium salt production from industrial effluent by utilizing waste tea leaves

Training provided to Clients

Sl. No	Title	participating Institution	Number of participant	Duration
01	Training on High Performance Liquid Chromatography	Pran Agro Limited	04	22 - 26 October 2017
		Jayson Pharmaceutical Limited	03	11, 18, 25 February 2018
02	Training on Gas Chromatography Mass Spectroscopy/ Mass Spectroscopy	Bangladesh Council of Scientific and Industrial Research	15	24-26 April 2018
		Directorate of Environment, Chittagong, Ministry of Forest	05	11-12 December 2017
03	Liquid Chromatography Mass Spectroscopy/ Mass Spectroscopy	Directorate of Environment, Chittagong, Ministry of Forest	05	13-14 December 2017
04	Gas Chromatography-FID			10 December 2017
05	Atomic Absorption Spectroscopy			17 December 2017
06	Fourier-Transform IR and Total Organic Carbon			18 December 2017
07	UV-Spectroscopy, BOD And COD			20 December 2017
08	Environmental			19

	Monitoring System			December 2017
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Training for DRiCM Personnel

SI No.	Title	Name	Organizer	Duration
01	Training on Innovation in Public Service	1. Farzana Hossain, SSO 2. Juwel Hossain, SO 3. Sumayia Akhter, SO	Bangladesh Council of Scientific and Industrial Research	16-17 November 2017
02	Capacity Building Training for Researcher	1. Farzana Hossain, SSO 2. Juwel Hossain, SO		06-15 May 2018
03	Training on e-filing	1. Md. Ashrafal Amin, Assistant accountant 2. Muhammad Neamat Imam, Assistant Administrative Officer		22-26 April 2018
04	Training on e-filing and basic computer	1. Razia Sultana, LDA		15-19 April 2018
05	Training on basic computer	1. Md. Tohidul Islam, Technician		24-28 June 2018
06		1. Abdul Wahab Dewan, Junior technician 2. Jhuma Akter, Junior technician		27-31 May 2018
07		1. Md. Ahad Hossain, Junior technician 2. Khondkar Fatematuz-johura, Junior technician 3. Md. Al-Amin, Junior technician		3-7 June 2018

Industrial Tour for solving industrial problem

SI No	Visited Industry	Name of Participant	Number
01	Marico Bangladesh Limited	1. Sumyia Akhter, SO 2. Juwel Hossain, SO	02
02	Directorate of Environment,	1. Md. Moniruzzaman, SO	03

Chittagong, Ministry of Forest	2. Mamudul Hasan Razu, SO 3. Juwel Hossain, SO	
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Analytical Service

Total 1944 analytical services against 445 requests were given in 2017-2018 financial year

Seminar

DRiCM organized a national seminar titled “R & D activities of DRiCM-2018” to present the research result of ongoing and completed R & D project.

Scientist pursuing M.S/M. Phil/Ph. D in home or abroad

SI No	Name	Awarded/pursing degree	Title	Name of Institution	Supervisor	Duration
01	Md. Arif Abdullah, SSO	Ph. D		Dept. of Chemistry and Biochemistry, Florida International University		August 2014-August 2020
02	Mirola Afroze, SO	Ph. D	Isolation of Bioactive Chemical Constituents and Investigation of Pharmacological activity of <i>Entada rheedii</i> and <i>Cyperus rotundus</i> .	Dept. of Pharmacy, Jahangirnagar University	Dr. Md. Sohel Rana Professor, Dept. of Pharmacy	2016-Till date
03	Md. Juwel Hosen, SO	Ph. D	Design of Potential Chemical Compounds for Photovoltaic Solar Cell by Computational Method	Dept. of Theoretical and Computational Chemistry, Dhaka University, Bangladesh	Dr. Md. Saiful Islam, Professor, Theoretical and Computational Chemistry	April, 2018-Till Date

Academic Research Guidance/ Supervision:

SI. No	Title of research	Research category	Name of Student	Name of academic Institution	Name of supervisors
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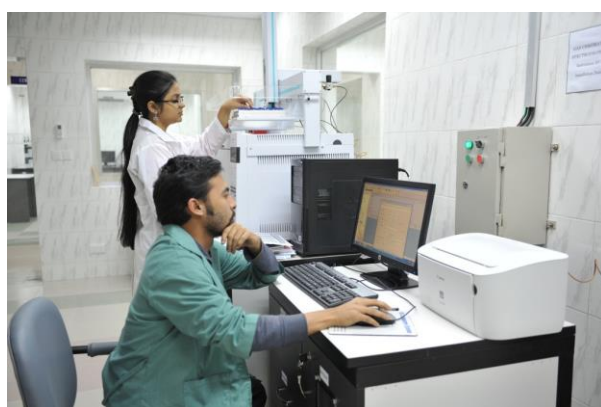
					in BCSIR
1.	Environment friendly clay coagulation aid for industrial effluent treatment plant	B. Sc	Sharmin Sultana	Dept. of Environment Science & Resource Management, Mawlana Bhashani Science & Technology University (MBSTU)	Dr. Mala Khan
2.	Insulin loading into physically and chemically cross-linked chitosan Hydrogel and its release profile analysis	M. Sc	Nayan kumer kundu	Dept. of Applied Chemistry and Chemical Engineering, Dhaka University	Dr. Mala Khan
3.	Preparation of zinc oxide nanoparticles incorporated chitosan-poly (ethylene glycol) bio-composite for wound healing	M. Sc	Rifat	Dept. of Applied Chemistry and Chemical Engineering, Dhaka University	Dr. Mala Khan
4.	Isolation and characterization of Bioactive Constituents of <i>Entada rheedii</i>	M. Sc	Farzana	Tejgaon college, national university	Dr. Mala Khan
5.	Investigation of accumulation of heavy metals from industry into food chain	M. Sc	Shakil	Institute of leather engineering and technology, Dhaka University	Dr. Mala Khan
6.	Isolation of Bioactive Chemical Constituents and Investigation of Pharmacological activity of <i>Entada rheedii</i> and <i>Cyperus rotundus</i> .	M. Phil	Mirola Afroze	Dept. of Pharmacy, Jahangirnagar university	Dr. Mala Khan
7.	Evaluation of physicochemical parameters of groundwater and	M. Phil	Md. Jalal Uddin	Dept. of Geography and Environment, Jagannath University	Dr. Mala Khan

	surface water of Rooppur Nuclear Power Plant (RNPP) area				
8.	Evaluation of inorganic and organic contaminations in food items available in the industrial zones around Dhaka city area	Ph. D	Fahmida jebin	Dept. of Applied Chemistry and Chemical Engineering, Dhaka University	Dr. Mala Khan

Pictures for each Unit/ Laboratory



NMR is operating by Dr. Mala Khan, CSO & Director



**Gas Chromatography-Mass Spectroscopy/ Mass Spectroscopy
GC-MS/MS**



Director (NML), CSIR, India visited DRiCM



“A national seminar is held in DRiCM on “R & D activities of DRiCM-2018”

Institute of National Analytical Research and Service (INARS)

Institute of National Analytical Research and Service (INARS) was established in September 2016. Since then INARS has been conducting research mainly in the field of analytical, environmental and natural products chemistry. This institute is specialized in doing research on water chemistry, more specifically mitigating arsenic and other heavy metal contamination in water. The current trend of research of this institute has also expanded to investigate the organic contaminants in water. A significant contribution in this area of research has come from INARS as it has been involved with arsenic removal technology verification process since last decade. Through this, the institute has come up with the solution to ensure arsenic free drinking water for everyone in Bangladesh.

Besides, INARS has achieved ISO 17025:2005 accreditation as a first ever govt. testing laboratory in Bangladesh. Initially, it received accreditation for thirty four (34) water quality parameters which has been expanded to seventy four (74) parameters this year. The institute is always committed to provide testing services compliant to international standard.

The institute has a dedicated team consisting 24 scientists and technical staffs. The team has been contributing in research and development since last few decades. The team is always committed to personal and professional integrity and work together to fulfill a clear vision of the institute.



R & D Activities:

Development of Low cost Arsenic Removal Technologies to mitigate Arsenic from contaminated water

Water intended for human consumption should be both safe and wholesome. Without ample safe drinking water, communities cannot be healthy. Arsenic contamination of groundwater in Bangladesh is widespread and acute and an estimated 30 million Bangladeshi (Heikens 2006) obtain their drinking water from shallow tubewells that are contaminated with arsenic above the national drinking water standard of 50 mg/l (Government of Bangladesh [GoB], 1997). Arsenic is poisonous and known cancers causing agent (Centeno et al. 2002, Loewenberg 2007) and approximately 10,000 - 30,000 Bangladeshis have already been diagnosed with arsenicosis (Heikens 2006). Thus, meeting the need for arsenic-safe drinking water in Bangladesh is urgent. Arsenic removal filters could help meet the needs of some arsenic-affected populations, especially in areas where no arsenic-free water sources are available. Indeed, as a supplementary option, filters could help the government.

Objectives

Developed a low cost Arsenic Removal Technology to mitigate Arsenic from the contaminated water and

- Provide technical information governing the performance of ART with various water matrices,
- Produce statements on the performance of ART under “real world” conditions,
- Support large-scale future technology deployment and installations
- Knowledge regarding the ART’s ability to remove other harmful chemicals from contaminated groundwater,
- Highlight ways and means of improving ART’s performance
- More importantly, obtain better knowledge and understanding of ARTs and their efficacy for generating safe drinking water for populations in arsenic-affected areas of Bangladesh

Progress

A literature review on existing technologies has been conducted for developing a low cost arsenic removal technology. One of the media and possible structure of this technology has been developed. Testing process is going on to find out how much arsenic it can remove, how much water it can treat without media saturation and tried to estimate its flow rate. Now we have tested it by using synthetic water. Site selection and well characterized has been done for real water testing.

Removal of Heavy Metals from Polluted Water Using Low Cost Adsorbent Materials

Heavy metal pollution has become one of the most serious environmental problems nowadays. The removal of heavy metals from the environment is of special concern due to their persistence. The presence of zinc, cadmium, nickel and others metals in the aqueous environment has a potentially damaging effect on human physiology and other biological systems when the acceptable levels are exceeded. Heavy metals cannot be degraded or destroyed. The conventional method for heavy metal removal includes chemical precipitation, membrane filtration, ion exchange, reverse osmosis, electro-dialysis, solvent extraction, evaporation, oxidation and adsorption. However, adsorption has proven to be economical and efficient for removing heavy metals, organic pollutants and dyes from polluted waters. In our work, a number of low cost adsorbent materials will be synthesized, processed and will be used as adsorbents for heavy metal removal.

Objectives

- To remove heavy metals from waste water and ground water using low cost adsorbent materials.
- To find out a suitable adsorbent materials which acts as better adsorbents for heavy metals removal.
- To prepare an appropriate media which will help local people to remove toxic heavy metals from ground water for drinking purpose.
- To minimize heavy metals pollution in surface water.
- To mitigate heavy metal pollution due to industrial waste water.
- To develop a new appropriate technology for heavy metals removal.
- To Support large-scale future technology deployment and installations.
- To gather knowledge regarding the ability of this technique to remove other harmful chemicals from contaminated groundwater and waste water.

Progress

Nine adsorbent materials including different oxides of Manganese, Graphene and their composites have been synthesized and characterized by XRD, FT-IR, SEM and TGA successfully. The materials are now using as adsorbent for heavy metals removal and this whole process is under working.

Removal of Lead from waste water by low cost Adsorbents

Heavy metals such as lead can often be found in industrial wastewater and their discharge to the environment poses a serious threat due to their acute toxicity to aquatic

and terrestrial life which includes humans. As a result of increasing industrialization more heavy metals are being continually released to the environment and this has prompted environmental engineers and scientists to investigate methods by which heavy metal-bearing wastewaters can be treated effectively and economically. Enhanced industrialization and discovery of various uses for lead however have caused humans to disinter it, which has caused the release of large quantities of the by-product of this material into air, soils and surface waters. It is used as an industrial raw material in manufacturing of storage batteries, television tube, printing, paints, pigments, photographic materials, fuels, matches and explosives. The manufacturing process of these materials produces lead-bearing wastewaters, which have to be treated and disposed of. One of the largest consumers of lead is the storage battery industry followed by the petroleum industry in producing gasoline additives. Lead concentrations in wastewater from battery manufacturing, acid mine drainage, tailing pond and steel production plants range from 0.5 to 25 mg/L.

Objectives

- To find out a suitable and low cost adsorbent material(s) for developing a technology to remove toxic lead metal from industrial waste water.
- To prepare an appropriate media which will be helpful for lead base industries to remove toxic lead metal from their effluent.
- To mitigate heavy metal (Lead) pollution in our environment due to industrial waste (polluted) water.
- To Support large-scale future technology deployment and installations.
- To gather knowledge regarding the ability of this technique to remove other harmful chemicals from contaminated waste water.

Progress

A nano-material, works as an adsorbent, has been synthesized using rice husk. The developed nano-material will be characterized shortly using different analytical techniques including SEM, XRF etc. Laboratory synthetic lead contaminated water has been treated using the developed nano-material. It was found that the material can successfully remove lead from water.

Chemical fingerprint profile of secondary metabolites of selected medicinal plants

Plants may be regarded as libraries of small molecule secondary metabolite organic compounds with considerable structural diversity, which would otherwise probably be unavailable in a synthetic chemical laboratory. Plants have developed chemical

defenses over millions of years against environmental threats such as UV radiation, reactive oxygen species and microbial attacks. Therefore phytochemicals are less toxic and biologically active. The present scenario shows the demand for plant drugs throughout the world because of its valuable phytochemicals. Now a day's new technology have made it possible to identify, screen and isolate these active compounds. The chromatographic and spectral fingerprints play an important role in the quality control of complex herbal medicines. Development of chemical fingerprints using TLC, HPLC is an effective tool for linking the identity for estimation of chemical and bio chemical markers. The advancement of TLC, High Performance Chromatography (HPLC) can provide an electronic image of chromatographic finger print and densitogram to detect the presence of a marker compound in the plant sample. It is efficient and economic for the analysis of broad number of compounds. It has the potential to determine authenticity and reliability of chemical constituent of herbal drug and formulation.

Objectives

1. To develop HPLC fingerprints to distinguish the adulterant and standardization of herbal formulations.
2. To develop analytical method for isolation of marker chemicals from the standard herbal drugs or medicinal plants.
3. To ensure the quality of the herbal drugs using modern analytical techniques, for therapeutic efficacy and safety.

Progress

Four medicinal plants *Adhatoda vasica*, *Andrographis paniculata*, *Asparagus racemonus* and *Withania somnifera* herbal monograph has been completed. Two compounds namely Neoandrographolides and quercetin 3-O-beta-D-glucopyranoside were isolated.

Development of value added products from *Aquillaria malaccensis* Lam (Agar) and *Tergetes erecta* Linn (Genda phul)

Agar is traded in several forms from large sections of trunk to highly processed fine products including incense and perfumes. The essence extracted from agar wood is now widely used as a fragrance to manufacture beauty soaps and shampoos etc. Trade in the agar wood dates back as early as the 13th century. Agar is one of the most promising non-timber forest products (NTFPs) of Bangladesh, and earned Tk.1 300M through exports of attar (agar oil) in 2004. About 25,000 workers were engaged in

cultivation, collection, processing and marketing of agar and agar-based products in that year. Despite the huge demand in local and international markets, no major extension program has so far been conducted by governments or other agencies in Bangladesh. The plant *Tagetes erecta* Linn. Locally known as Genda Phul (Marigold) belongs to the family Asteraceae. It is a stout, branching herb, native of Mexico and other warmer parts of America and naturalized elsewhere in the tropics and subtropics including India and Bangladesh. The flower is useful in fevers, epileptic fits (Ayurveda), astringent, carminative, stomachic, scabies and liver complaints, skin diseases and is also employed in diseases of the eyes. The Essential Oil of *Tagetes* is extracted from its leaves, stem, stalk, and flowers by the process of steam distillation. The main components of this oil are limonene, ocimene, tagetone and valeric acid.

Objectives

- To Extract, Fractionate and characterize of the active ingredients from *Aquillaria malaccensis* Lam and *Tagetes erecta* Linn.
- To evaluate the biological activities of the extracts as well as active ingredients.
- To develop of value added products from these active ingredients.

Progress

The antibacterial and antioxidant activities as well as phytochemical screening of different extracts of *Tagetes erecta* L flowers have been completed. Two compounds were isolated from the ethylacetate extract by Column Chromatography and identified as Erythrodiol-3-palmitate and α -Amyrin palmitate by NMR studies.

Development and validation of analytical methods for the estimation of vitamins in medicinal and dietary products

Vitamins are organic compounds, essential nutrients, which are important to human and animals for the existence of their life. Vitamins are also crucial for the maintenance of good health. Our body obtains them from our diet. Most of the vitamins needed are found in foods. Shortage of vitamins in our body can develop deficiencies and result in health issues. Often doctors prescribe vitamins supplement to make up shortages. For this reason, the estimation of vitamins in medicinal and dietary products needs to be checked and it is very essential, in order to ensure correct intake and the accuracy of the label statements.

Objectives

1. To develop a selective and sensitive analytical method for rapid quantification of water and fat soluble vitamins in various matrices.
2. To validate the analytical methods for specific vitamins in different matrix (plant products, dairy products, poultry products, beverages and drinks, candies, baby cereals and vitamin syrups etc).
3. To obtain ISO/IEC:17025 accreditation on analysis of vitamins in food supplements.

Progress

A literature review on existing analytical methods has been conducted to find out the possible methods for application and room for further improvement. Standards of water and fat soluble vitamins such as vitamin B₁, B₂, B₅, B₆, B₉, B₁₂, ascorbic acid, Vitamin A, D, β -carotene etc. have been purchased separately and a mixed standard of the vitamins has been prepared. The prepared mixed standard has been analysed using High performance liquid chromatograph and separate peaks are identified for individual vitamin standard. Some parameters e.g., linearity, specificity, method detection limit are determined as part of validating the developed method. Some of the food supplementary products e.g., baby cereals, vitamin syrups have been collected from local market to examine the amount of vitamins if they comply with the concentration shown on the label of the product.

Isolation and characterization of Bioactive compounds from *Anethum sowa* Linn.

The main aim of this R&D Project is to discover novel, potent and selective compounds with potential activity to treat diseases. All aspects of this programme have been designed to streamline the isolation, evaluation, purification and characterization of potentially useful bioactive compounds. The purpose of extensive phytochemical research is to isolate the active constituents in the pure form to avoid unwanted effect and to ensure safe use of herbal medicines.

Objectives:

The objective of this research project is to discover novel bioactive molecules from medicinal plants such as *Anethum sowa* Linn. (Family: Apiaceae ; Bengali name: Shulfa, Soya, Solup, Hoilfa, Sowa) using modern separation, isolation and

spectroscopic techniques. Value addition of discovered bioactive molecules will be achieved through the development of precise, rapid and sensitive analytical method of detection and quantification useable for the quality evaluation of the source, followed by the non-destructive extraction, fractionation and isolation processes. The isolated bioactive molecules will be assessed for their safety and efficacy in animal models to find out the suitable lead compounds for the clinical study. Logical modification of constituents will be attempted for improved activity.

Progress

The plant *Anethum sowa* Linn was collected from Karanigonj, Dhaka and it was identified by Bangladesh National Herbarium .The stems and seeds of the plant were extracted separately by n-hexane, dichloromethane, ethyl acetate and methanol in successive manner. Total eight extracts from different parts of the plant were examined for their bioactivity like Cytotoxic, Antimicrobial ,Antioxidant, Thrombolytic, Membrane Stabilizing, Antidiarrhoeal , Analgesic and Hypoglycemic activity using different well established bioassay procedures. The results of these bioassays were encouraging. Preliminary phytochemical screening of the plant extracts were performed & many valuable bioactive metabolites were found. Analyses of proximate composition, mineral, heavy metal contents and gas chromatography-mass spectroscopy (GC-MS) of different extracts have been carried out by separate experiments. The results of these analyses were significant.

Assessment of physicochemical properties of rainfall water in Bangladesh.

Groundwater has been reported to be contaminated by the Arsenic (As) in Bangladesh since 1993, which was highly hazardous for human health and for food safety as well. To overcome the As contaminated health hazards, rainwater harvesting was found to be one of the best remedial measures for the rural people of Bangladesh. Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately warm temperatures, and high humidity. The number of mills and industries is increasing day by day. The time has come to identify the correlation between the quality of rainwater and the emission of the medium and heavy industries in the different area of Bangladesh.

Objectives

To assess physicochemical properties of rainfall water in different regions (Dhaka, Chittagong, Rajshahi, and Khulna) of Bangladesh during Spring, Summer, Autumn and Winter season. To assess the rainfall water whether it is acidic or not in different regions of Bangladesh. To investigate the variation of different physicochemical properties like PH, Electrical Conductivity, Acidity, Alkalinity, Hardness, Carbon dioxide, various anions, Volatile Organic Carbon, Total Organic Carbon, Total solids, Total dissolved solids, Silica, Lead etc of rainfall water. To use statistical data on physicochemical properties of rainfall water to harvest rainwater for drinking and agriculture purposes more scientific method.

Progress

Rainwater sample was collected two times in February and June in 2018 from Dhaka, Chittagong, Rajshahi, and Khulna and tested. The analysis result was significant. The dissolved oxygen of rainwater of Dhaka is the lowest and Rajshahi is the highest among collected samples. The quality of rainwater of Rajshahi and Khulna is better than that of Dhaka and Chittagong.

Scaling and Modeling on bottled and filter water quality from locally available in Bangladesh.

Water is a basic need in ours daily life and is essential in carrying out various physiological functions in the human body. Humans can survive without food for a month, but they can survive without water for only seven days. More than 50 national, regional, governmental and non-governmental industries produce drinking water every day but this water are not fulfil our demand or sanitation. Lack of law and policy of drinking water most of the company produce distilled water which very harmful to our health. The demand of drinking water incised day by day million liters per day so we should be careful about this matter. Government will be able to implement drinking water related law and policies.

Objectives:

- To determine the minimum amount of mineral should be in drinking water
- To make scaling of water quality parameters in bottled water.

- To monitor on the bottled water and filter water in the local market and making a data sheet for modeling.

Expected outcome of the project:

- Publish papers in international Journals.
- Determine fix amount of minimum mineral in drinking water
- Make sure a data sheet for modeling.
- Make sure scaling of water quality parameters in bottled water

Recommended to government for implement of water law and policies

Easy process development of desalination from saline water in Bangladesh.

Salinity problem is the common problem in Costal area of Bangladesh. River or sea water available in Bangladesh but this water is not drinkable. The demand of drinking water incised day by day million liters per day so we should be careful about this matter. Every city has fallen below the level of water so it is time to do alter. Without mineral we do not ensure a defense against several diseases, such as congenital cataracts, nephrogenic problems, and diabetes. Government may earn foreign currency by the way of import business and fulfill domestic interest. Government will be able to implement drinking water related law and policies.

Objectives:

- Salinity free drinking water
- To enrich values of potassium and sodium reflect its alleged ability to affect the human nervous system by drinking water.
- To make sure higher concentration of calcium and magnesium in drinking water this helps to maintain strong bones.
- To confirm the balanced mineral and nutritional composition of drinking water.
- To product higher quality of drinking water for drinking purposes obviously helps all kinds of people in Bangladesh.

Expected outcome of the project:

- 1. Publish papers in international Journals.
- 2. Development allow cost process which will be commercially important
- 3. Development an easy salinity refines process of sea or river water.
- 4. Recommended to government for implement of water law and policies

Achievement

Research Papers

Sarwar Jahan., M. Azharul Islam., M. Mostafizur Rahman., Jannatun Nayeem., Shamim Ahmed and M. A. Quaiyyum. Steam and hot water pre-hydrolysis of bamboo and its Effect on residual lignin structure and pulping. *Cellulose Chem. Technol.*, 51 (5-6), 455-463 (2017).

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Participation in Foreign Training:

Shamim Ahmed, SSO has successfully completed fellowship programme on “parameterization of pH dependencies of spectral parameters for selected CWC-related chemicals and preliminary studies of plasma sample analysis using NMR” held in University of Helsinki, Finland on 01 September 2017 – 28 February 2018.

Scientist pursuing M.Phil/Ph.D courses in home and abroad

Sabina Yasmin, SO, awarded Ph.D Degree on “Metal-carbon nanomaterials as high performance catalyst for fuel cell and bio-molecule sensing” on 2018.

Md Abu Bakar Siddik, SO, awarded M.Phil degree on “Electrochemical capacitive properties of synthesized nano structured manganese oxides-graphene composites” on 31 March 2018.

Academic Research Guidance/Supervision

Sl. No	Title of research	Research category	Name of student	Name of academic supervisor	Name of BCSIR supervisor
1.	The chemical analysis of natural products of medicinal plant <i>Cuscuta reflexa</i>	MS	Nahid Sajia Afrin	Prof. Dr. Koushik Saha	Mr. Aminul Ahsan

2.	The chemical investigation of medicinal plant <i>ctusifolia</i>	MS	Tarannum Tasnim	Prof. Dr. Koushik Saha	Mr. Aminul Ahsan
3.	Removal of heavy metals (Cr and As) from waste water using chitosan based adsorbants	MS	Ekram Hossain	Dr. Shah Muhammad Masum	Mr. Ahedul Akbor, SSO

Major Instruments



High Performance Liquid Chromatograph



Elemental Analyzer

Working Picture

