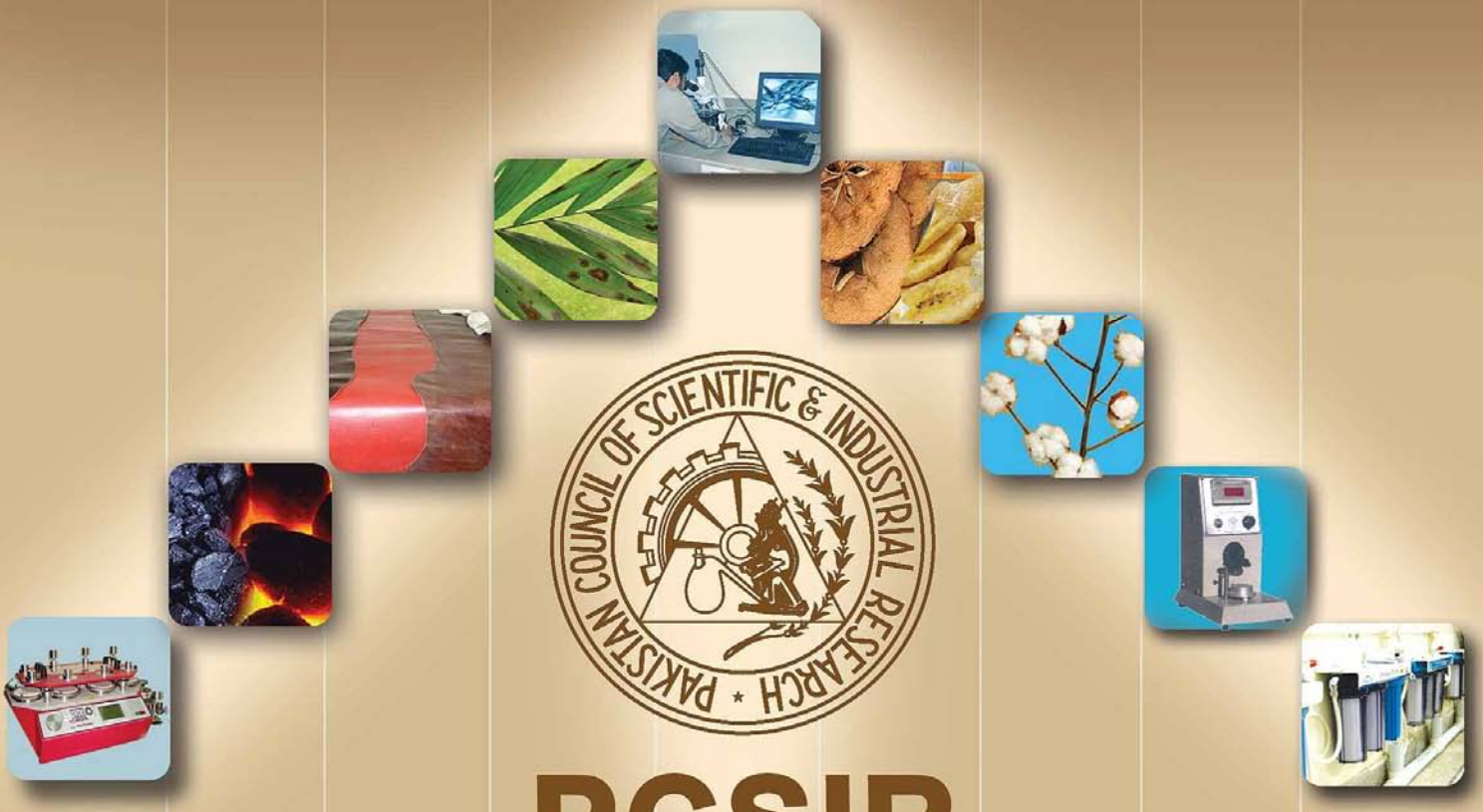

PCSIR
RESEARCH & DEVELOPMENT
PROGRAMME 2014 - 2015

Pakistan Council of Scientific and Industrial Research

PCSIR
Research & Development Programme

2014-2015

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Pakistan Council of Scientific and Industrial Research
Shahrah-e-Dr. Salimuzzaman Siddiqui, Karachi-75280

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Dr. Kaniz Fizza Azhar
Director SIC

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December, 2014

FOREWORD

The new and emerging technologies like biotechnology, nanotechnology/ engineering and composite/ advance materials beside the existing technologies are being adopted rapidly worldwide in tandem with the trade regulations and the WTO regime. Only those nations will survive and prosper who foresee the future trends, acquire knowledge, plan and develop expertise in rising and budding sciences. Envisaging the future trends and requirements for Scientific and Industrial development at national level, PCSIR plans its R&D programme every year.

PCSIR has four multi-functional Laboratories at Karachi, Lahore, Peshawar, Quetta and four mono-functional research centres, viz. Leather Research Centre, Fuel Research Centre, National Physical and Standard Laboratory and Institute of Electronics Engineering (IIEE).

PCSIR Laboratories are accredited Laboratories of Pakistan for ISO-17025 and have been accredited by Pakistan National Accreditation Council (PNAC). The award of ISO-17025 to PCSIR Laboratories authenticates that the services offered by these Laboratories are credible and according to the application of the international standards as specified in ISO-17025. By availing the accredited testing and calibration services offered by PCSIR, the industries, manufacturers, exporters and traders of Pakistan are able to get their products accepted worldwide according to the requirements of WTO. The major exports of Pakistan are textile, leather, food sports and surgical goods and products which are based on locally available raw materials. The exports are made to Western European countries, America and Japan. PCSIR is doing its best and has established Dioxin/ Pops testing laboratory for providing services to the stakeholders of fish, fisheries, seafood and products for the resumption of fisheries export to the European markets. This is South Asia's first Dioxing Testing Laboratory in Karachi established with the assistance of European Union and UNIDO.

Development budget of PCSIR for the year 2014-15 is Rs. 440.803 million whereas non-development budget is Rs. 1701 million.

Envisaging the current priorities and future obligations, the R&D Programme for the year 2014-15 has been planned and is being presented to the August forum of PCSIR Council members for kind consideration and to seek guidance for its future endeavors.

Comments and suggestion are invited from all stakeholders for achieving the national progress and prosperity through Scientific Research & Development.

(Muhammad Ejaz Mian)
Chairman PCSIR

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ADVANCED AND COMPOSITE MATERIAL, PLASTICS AND POLYMERS

Title: **Development and Characterization of Industrial Waste-Polymer Composites**

Project Leader: Farzana Habib

Project Associates: Khalil Ahmed, Khalid Mahmood, M. Aijaz, Nudrat Zahid Raza

Year of Initiation: 2013

Duration: 02 years

Background:

Large quantities of stone and marble wastes are produced in their respective processing industries in Pakistan as a result of different mechanical effluent processes. This industrial waste is generated as a by-product in the form of dust during the cutting process of giant blocks. This imposes threats to eco-system and their removal is a universal problem now a days. Therefore utilization of these waste materials to develop composites will help to protect environment.

Over current decades, various new innovative composites have been developed because of their unique flexibility in design, tailoring and other characteristics such as simplicity of manufacturing, top specific strength, corrosion resistance, durability, stiffness, malleability and cost effectiveness have attracted the interest of material scientists and technologists. The waste materials can be used to generate new product to save environment from waste deposits.

Objectives:

- To investigate the effect of fillers loading of different particle sizes.
- To develop and characterize the possible processes for manufacturing industrial waste filled composites at lab scale.

Present Status: To be continued

Target for 2014-2015:

To design and explore the value added products by converting this project to solve the future disputes as per requirement of country.

Title: **Production of Polyhydroxybutyrate, a Biodegradable Polymer**

Project Leader: Quratulain Syed

Project Associates: Yasar Salim, Rubina Nelofer, Muhammad Nadeem, Sania Mazhar, Abad Ali Nadeem, Ammara Hassan

Year of Initiation: July, 2013

Duration: 02 years

Background:

Plastic materials, have made their entry in every sphere of human life, are now causing serious environmental problems due to their non biodegradability. To combat this one option is to produce truly biodegradable polymers, which may be used in the same applications as the existing synthetic polymers. A fully biodegradable polymer is defined as a polymer that is completely converted by living organisms, usually microorganisms, to carbon dioxide, water and humic material. Among different biodegradable materials Polyhydxoybutyrates (PHBs), are of special interest because they possess thermoplastic characteristics and resemble synthetic polymers.

Plastics produced from PHBs have been reported to be truly biodegradable in both aerobic and anaerobic environments. Among 89 different forms of PHAs in bacteria, only two forms of PHAs, *i.e*., PHB homopolymer and 3HB-3HV copolymer are commercially produced. The accumulation of PHB by microorganisms can be stimulated under unbalanced growth conditions, *i.e*., when nutrients such as nitrogen, phosphorus or sulfate become limiting, when oxygen concentration is low, or when the C: N ratio of the feed substrate is higher. PHB is accumulated by numerous microorganisms and is best characterized PHA. PHB was first discovered in bacteria. It is an unique intracellular polymer accumulated under stress conditions but with excess carbon source. During starvation, PHA serves as carbon and energy source and is rapidly oxidized thereby retarding the degradation of cellular components, combating the adverse conditions as in rhizosphere. A number of bacteria such as *Enterobator*, *Azotobacter*, *Bacillus,* Archaebacteria, Methylobacteria, *Pseudomonas* have been found to synthesize PHA to varying levels.

This project is designed for the production of PHBs from *Enterobacter aerogenes* and *Bacillus thuringiensis* using cheaper solvents i.e. molasses whey.

Objectives:

- Isolation, identification and characterization of suitable non *Enterobacter aerogenes* and *Bacillus thuringiensis* strains.
- Standardization of PHB and optimization of fermentation process to enhanced PHB production.
- Scale up of fermented PHB production upto 30 L bioreactors.
- Microbial degradation studies of PHB in compost and controlled microorganisms.

Present Status: To be continued

Targets for 2014-2015:

- Isolation and characterization of suitable strains.
- Optimization of PHB production.
- Standardization of PHB
- Process optimization.

Title: **Development of Fire/ Flame Retardant Thermoplastic Material**

Project Leader: Syed Junaid Mahmood

Project Associate: AFK Ifrahim

Year of Initiation: 2013

Duration: 02 Years

Background:

Using flame retardant technologies to reduce fire hazards is a basic element of product safety. Fire retardance is achieved in plastics through chemical reactions that moderate one or more of the elements (fuel, heat, or oxygen) necessary for burning to take place. There are a number of ambiguous terms used to describe plastics incorporating flame retardant systems, all of which have similar intent: fire retardant, ignition resistant, and self-extinguishing materials. Even with temperature and chemical exposure flame retardant treatment, no plastic can be rendered entirely fire proof.

Plastics used in computers, printers, dryers, vehicles, and many other common products, may need to be protected by incorporating a flame retardant system. Some polymers, such as fluoro-polymers and poly-sulfones, are inherently flame retardant. Other polymers – including

nylons, polyesters, polypropylenes and many other useful and cost-effective materials, are not. They must be modified to achieve the proper level of fire resistance through the use of flame retardant additives. Each year, billions of pounds of flame retardant additives are used throughout the world. Different flame retardant chemistries, packages, or systems can be strategically deployed in polymers depending on the requirements of individual end-use applications and impacting regulations.

Objective:

Flame Retardant (FR) compounds that ensure the product safety by providing ignition resistance, but are also environmentally-friendly without compromising physical performance. Halogen-free FR compounds make product/ material comply with HES (Human and Environmental Safety) standards allowing a single version to be sold worldwide. Environmental regulations, such as the European RoHS Directive, limit or ban the sale of products containing certain halogen FR systems.

Present Status: To be continued

Target for 2014-2015:

Thermo plastic flame / fire retardant material will be developed having impact resistance, chemical inertness, flame proof characteristic, free from halogen and also having low Limiting Oxygen Index. (*LOI*) that complies RoHS Environmental Regulation.

BIOTECHNOLOGY

Title: **Development of HA Coating on Orthopedic Implants with Animal Trials**

Project Leaders: Shahzad Alam, Muhammad Irfan

Project Associates: Ali Imran, Naseem Zahra, Muhammad Fayyaz, Salman Ahmad

Year of Initiation: 2014

Duration: 01 year

Background:

After successful trials of spraying Hydroxyapatite on Hip joint by Oxy fuel spray system and Plasma spraying system, it was found that Adhesion problem can be controlled by selecting the parameters for plasma spraying technique in a better way.

Brief:

Hydroxyapatite as a bone substituted material is being successfully used as a filler material in a body. This material can be used on orthopaedic implants by plasma spraying technique. By using this technique the biocompatibility of implants also increases by avoiding the slippage action of implants in a body which causes continuous pain to the affected patient.

Coating Material: HA Powders

Coating Technique: LVOF
Plasma Spray

Substrate: Mild Steel
Stainless Steel

Objectives:

- Production of Hydroxyapatite from egg shells.
- Development of HA coatings on implants by plasma spraying.
- Optimization of coating parameters.
- Animal trials.
- After successful animal trials delivery of implants for patients.

Achievements:

- HA material has been developed.
- Characterization of HA material has been done.

Present Status:

- Trials are being made to optimize the properties required for mass production.

Targets for 2014-15:

- The product shall be ready for commercialization after successful animal trials.

CHEMISTRY AND FINE CHEMICALS

Title: **Development of Antiscalent, Anticorrosion and Membrane Cleaning Chemicals for Reverse Osmosis Systems**

Project Leader: Tahir Rafique

Project Associates: Khaula Shirin, Sofia Khalique Alvi, Sheraz Shafiq

Year of Initiation: 2014

Duration: 02 years

Background:

The increase in global demand for potable water exerts considerable pressure on the supply from conventional freshwater sources, such as rivers and lakes. Thus, alternative solutions that extract clean water from less conventional sources, such as the treatment of groundwater and seawater from Reverse Osmosis membrane technology for indirect potable use are gaining popularity. However, the use of membrane technology in water treatment is impeded by the phenomenon of scaling, corrosion and fouling. Chemical cleaning agents are commonly used to remove scale and foulant deposited on membrane surfaces. Typical chemicals used for membrane cleaning and to prevent it from scaling and corrosion include mild acids, alkaline solutions, metal chelating agents, surfactants, and salt solutions. Most of these chemicals are imported from abroad; therefore there is a great need to develop these chemicals locally to meet the demand of the country.

Objectives:

- To carry out R&D for the development of RO membrane treatment chemicals to save the foreign exchange of the country.
- To provide advisory/analytical services to water treatment Sector.

Present Status: New project

Title: **Preparation of Chelated Micronutrients Fertilizers**

Project Leader: Rashid Ali Siddiqui

Project Associates: Muhammad Kamil Ghulam Fareed

Year of Initiation: 2013

Duration: 02 Years

Background:

Pakistan is an agricultural country and about 65% of its population is related to the agriculture Sector. Macro and micro nutrients fertilizers are required for the better yield to support our economy. In Spite of macro nutrients, micro nutrients also play an important role in the growth of plants. Two types of micro nutrients fertilizers are being used, chelated and non-chelated micro nutrients fertilizers of metals like Zn, Mn, Cu etc. Metal ions are important for plants. Their deficiencies result in yellowing the leaves, retarded growth and in general low quality crops. Chelated compounds are more stable than non –chelated compounds.

Therefore metallic chelates are widely used in agriculture as micro nutrients fertilizers to supply plant with Iron, Mn, Zn, Cu.The most common chelating agents are EDTA, DPTA, etc.

Objectives:

- To prepare metallic chelated compounds for agriculture sector.
- To reduce the import of such micro nutrients fertilizers by substituting locally produced products.

Present Status: To be continued

Target - 2014-15:

Minimum 2 metallic chelated fertilizers will be prepared to market the products.

Title: **Synthesis of Pthalocyanine Based Dyes & Pigments**

Project Leader: Farooq Arif

Project Associates: Rana Amjad Tayyaba Ahmad

Year of Initiation: July 2013

Duration: 02 years

Background:

Pthalocyanine is a macro-cyclic compound, consists of four iso-indole-class [(C_6H_4) C_2N] units linked by four nitrogen atoms to form a conjugated chain, which take part in hosting various different metal ions in its center. This structure shows a striking feature as a colorant like porphyrins (bio-pigments) in nature. Phthalocyanine derivatives derived from the basic compound of $(C_6H_4C_2N)_4N_4$ are used as light-fast blue or green pigments. The hosted metals and substituted groups result in the distinct colors; pthalocyanine (blue-green), copper pthalocyanine (blue), chlorinated copper pthalocyanine (green), and sulfonated copper pthalocyanine (green). Recently they are involved in the study of photo-sensitizer chemistry or metal complex chemistry such as transition-metal complex catalyst chemistry for uniform polymerization, luminescence chemistry and Spectrophotometric analysis, organic synthesis and polymerization. Phthalocyanine pigments are used in enamels, inks, plastics, and rubber goods. Some pthalocyanines such as fluor-aluminium pthalocyanine are used in cancer treatment.

Due to *pi*-electron cloud overlaps, pthalocyanines exhibit semiconductor property. Organic semiconductors have some merits of self radiation, flexibility, light weight, easy fabrication, and low cost. They have been investigated as organic electroluminescence materials for the applications in organic solar cells, bio-sensitizers and display devices such as O.L.E.D (Organic Light Emitting Diode), O.T.F.T (Organic Thin Film Transistor) & Wearable Display.

Objectives:

Local industry in Pakistan is far behind in producing pthalocyanine based dyes. The aim is to support the local Industry in synthesising pthalocyanine based dyes.

Present Status: To be continued

Future Plan: Pilot plant synthesis of these dyes

Title: **Extraction and Evaluation of Curative Natural Dyes**

Project Leader: Farooq Arif

Project Associates: Lubna Liaqat, Rana Amjad, Tayyaba Ahmad, Azra Yaqoub

Year of Initiation: January, 2013

Background:

Recently the interest in natural dyes has been growing rapidly due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reactions associated with synthetic dyes. The synthetic dye stuff produces hazardous by-products some of which possess carcinogenic intermediates and hence a ban has been imposed by Germany and some other European countries on the use of benzidine dyes in textile garments imported to their countries. Hence due to current eco-consciousness the use of natural dyes has gained momentum due to the increased demand for these dyes by the food, pharmaceutical, cosmetic as well as the textile colouration industry.

Objectives:

- To identify the cheap and easily available source of natural dyes.
- To develop the economic way for extraction of natural dyes under optimised conditions.
- To do the biological screening of the extracted dyes.
- To produce dye on commercial scale.
- To publish the research findings in reputable journal.

Achievements:

Extraction, application and evaluation of following natural dyes have been completed:

- Walnut (Bark)
- Jambulan (bark)
- Pomegranate (bark)
- Accacia (bark)
- Turmeric (roots)

Future Plan:

- Exploring other indigenous medicinal dye yielding plants. Then to extract, evaluate and study applications of the extracted natural dyes.
- Preparation and formulation of following:
  - Naturally coloured cotton bandages
  - Natural dyes for pharmaceutical preparations

Title: **Development of Industrial Chemicals**
[*Printer Cartridge Cleaner, Leather Strop Cream, Cocoamide DEA, Wire enamel Remover*]

Project Leader: Muhammad Zia-ur-Rehman

Project Associates: Rabia Nazir, Abdus Saleem, Amina Mumtaz, Shafaq Mubarak

Year of Initiation: January 2013

Duration: 02 Years

Background:

Small and medium entrepreneurs are playing vital role in the development and uplifting of the country's economy. They often visit PCSIR for the development of their desired chemicals as well as raw materials due to problems associated with their import and price compatibility. The basic aim of this project is to develop such chemicals/ products locally and to strengthen the expertise of local industries and national economy.

Objectives:

- To synthesize various industrial chemicals and products at laboratory scale from cheaper sources.
- Optimization of reaction conditions.
- Up-scaling of the processes to meet the requirements of the clients.

Achievements *(Since the start of the project)*:

- Gel Fuel *(Leased out)*.
- Solid Camping Fuel *(Leased out)*.
- Ice Gel *(Leased out)*.
- Automobile Engine Coolant *(Leased out)*.
- Soluble Zinc (Zincole ST) *(Production Activity)*.
- Dimethoxymethane – A general purpose solvent *(Ready to be leased out)*.
- Mosquito Repellant *(Developed; produced and distributed to avoid dengue)*.
- Deodorized Kerosene Oil *(Solvent for odorless paints and insect killers) Developed & is ready to be leased out*.
- *para*-Toluene sulphonic acid - *Catalyst for industrial esterification (Ready to be leased out)*.

Present Status:

- Work on following items is in progress:
  Hexamine: (Strategic chemical; Sample has been prepared and after POF's evaluation it is being improved).
- Wire Enamel Remover:
  A composition for the removal of enamel from copper wire without affecting its gauge has been prepared and is ready to be leased out.
- Leather Strop Cream:
  A composition of leather strop cream has been prepared and sent to the client for evaluation. Results are awaited.
- Printer Cartridge Cleaner:
  Development of formulation of cleaner of heads of commercial Printer cartridges is underway. Samples are being developed for evaluation by the client.

Title: **Optical Brightener (4, 4'-Bis-(2-Sulphostyryl) Biphenyl Based) Agent**

Project Leader: Ehsan ul Haq

Project Associates: Atif Latif Hamood ur Rehman

Year of Initiation: July 2013

Duration: 02 years

Background:

Paper and pulp industry is one of the growing industry in Pakistan. Optical brightening /florescent agent (4,4'-bis-(2-sulphostyryl)biphenyl based) are extensively used in paper manufacturing for achieving optical compensation of yellow and highest possible whiteness of paper during finishing operation. These are also extensively used diversified number of industries like textile, detergent and plastic etc. Optical brighteners are at present imported and there are limited manufacturing units in Pakistan which can not meet the requirement of country.

Objectives:

- To meet the requirement of paper and pulp industry.
- To develop indigenous technology for SMEs.
- It will be import substitution.

Achievements:

- Lab. Scale Sample of Optical brightening agent has been prepared
- Reaction conditions have been optimized

Present Status: To be continued

Title: **Preparation of Formaldehyde-2-Naphthalene Sulfonic Acid**

Project Leader: Ehsan ul Haq

Project Associates: Atif Latif Hamood ur Rehman

Year of Initiation: July 2013

Duration: 02 years

Background:

Today, 90% of paper pulp is made of wood and represents 1.2% of the world's total economic output. Recycling of paper and paperboard is a major business; recovered fibre contributes 46% of the fibre used in the paper industry worldwide. Paper recycling is the process of recovering waste paper and remaking it into new paper products. To get an easier and fast defibration, the addition of non foaming wetting agents (e.g. nonionic surfactant) and dispersant is used. Naphthalene sulfonic acid- formaldehyde condensate is mainly used for repulping of waste paper and papermaking process.

Objectives:

- To meet the requirement of paper and pulp industry.
- To develop indigenous technology for SMEs.
- It will be import substitution.

Achievements:

- Lab. Scale Sample of Formaldehyde-2-naphthalenesulfonic acid has been prepared
- Reaction conditions have been optimized

Present Status: To be continued

DESIGN AND DEVELOPMENT OF EQUIPMENTS

Title: **Commercialization of Solid-state Incubator Based on Peltier Module for Bacterial analysis**

Project Leader: Fasial Ghazanfar

Project Associates: Muhammad Yaqub, Arif Karim, Engr. Ajeet Kumar Bhatia, Kashif Hussain, Syed Junaid Hasan, Ahsan Ali, Farhan Abbasi

Year of Initialization: 2013

Duration: 02 Years

Brief:

The solid-state incubator incorporates a high precision Peltier Effect Modules available in local market that can work as a refrigerant, as a heat flux or temperature regulation system. The Peltier modules are cost effective and their designs are very simple. It does not require any cooling arrangement like refrigerant (cooling gas), compressor, condenser, evaporator and the associated piping, thus, making it environment friendly. Two such Peltier modules with heat sink are sufficient for a 40 litre chamber. In the design the sample is placed under controlled temperature conditions in which the temperature within the incubator chamber is kept constant without heat supply from outside by permitting the cooling and solidification of a substance.

Objective:

- To develop a commercialized model of Solid-state Incubator based on Peltier effect temperature control module.
- To develop a model, simple in design, rugged in construction and economical to manufacture and simple in operation.
- To develop a low cost and portable unit, working with 12V battery.

Present Status: New project

Target for 2014-2015:

- Purchase of Electromechanical components.
- Lab scale System analysis & development.
- Hardware & Software development.
- Final testing & evaluation.

ENVIRONMENT

Title: **Formulation, Evaluation and Clinical Trails for the Production of Medicinal Drinking Water**

Project Leader: Alia Bano Munshi

Project Associates: Sarwat Ismail Farooq Ahmed Khan

Year of Initiation: 2012

Duration: 03Years

Background:

Process of developing medicinal drinking water with medical fact sheets to provide medical practitioners with health data relevant to drinking water composition that may contribute significantly to the daily calcium, potassium and iron intake for patients with their deficient diets. This work has begun, and will initially focus on the elderly, children and women. In addition, CES has planned to formulate the drinking water as per deficiency of mineral and essential metals because it a requirement for all such patients suffering from diseases due to deficiency of Ca, K and Fe. etc

Potassium and calcium are very important minerals that help us feel healthy on all angles of the act of sustainment**.** Potassium is known as Natural Diuretic as it easily gets absorbed by our body up to 85-90%. A medical condition in which our body fails to retain minimum necessary amount of potassium required for its day to day functioning is called as Potassium deficiency or hypokalemia. Symptoms of Hypokalemia are Fatigue, Acne problem and Skin related problems etc. Hypokalemia is generally treated by treating the symptoms, to improve potassium level in body and may be provided to our organisms by food, but even the diets rich in calcium and Potassium intake may not be able to fully compensate. Similarly iron is a very vital mineral that is needed by the human body. Iron being an important nutrient, is included in many diets and is prescribed by health departments and relevant agencies. Drinking water may contribute significantly to the daily Ca, K and Fe intake for patients with Ca, K and Fe-deficient diets. Red meat and poultry products are considered as important sources of iron. Leafy vegetables and fruits are also important sources of iron.

Objectives:

- Provision of the recommended intake for healthy adult according to recommended daily intake of Ca, K and Fe on the average water intake of 1.7 L/day.

- Determination of concentration of Ca, K and Fe of sample of municipal tap water and bottled and mineral drinking water in averages and ranges (where available).

Achievements:

- K-medicinal water has been formulated and evaluated by clinical trials on Renal Tubular Asteorosis (RTA) patients.
- SMEs has appreciated the medicated water and expressed interest in setting up of plant with technological help of PCSIR for making value added water for the mass production.

Present Status: To be continued

Targets for 2014-15:

- Formulation and evaluation of Ca and Fe fortified water.
- Clinical trials on nutrient deficient patients.
- Determination of Calcium, Potassium and iron in tap and bottled waters.
- Formulation and evaluation of Ca, K and Fe added water as per recommended intake
- Clinical trails for impact of Medicinal water on health of deficient patients.

Title: **Determination of Dioxin and Furan in Food and Fisheries Products**

Project Leader: Alia Bano Munshi

Project Associates: Sohail Shaukat Hina Ahsan

Year of Initiation: 2013

Duration: 02 years

Background:

The goal of the research is to assess the status of POPs pollution from Karachi coast i.e. how natural changes with time factor are affecting the marine life. Dioxin and Furane being persistent in nature and dispersed contaminants of marine environment. They are mutagenic and carcinogenic environmental contaminants that are widely present in the air, water and aquatic system, soils and sediments. It is understood that Dioxin and Furane, are present in the aquatic environment, mainly as a result of inefficient removal in case if any oil spill incident such as Tasman Spirit oil spill during 2003. Previously however the distribution, lifetime, and bioavailability of persistent organic pollutants (POPs) like Dioxin and Furane in the Arabian Sea was studied at the time of incident.

Objectives:

- Dioxin and furane assessment and prepare a preliminary course portfolio for education of all concerned workers.
- To identify and classify the feasible and implementable remedial measures to opt technologies.
- To apply advanced and reliable techniques for analysis of each chemical by observing quality assurance and quality control.
- To identify the root cause of Dioxin and furane pollution and emerging problems.
- To develop secure, sustainable and cost-effective remedial techniques.
- To transfer the technology to end-users of maritime.
- To provide educational programs on the application of risk science to reduce the health risk presented by environmental pollution.

Present Status:

A renovated lab facility has been established at KLC-CES for testing/ analysis for commercial purpose.

Targets for 2014-2015:

As extended scope application has been filed for accreditation of ISO-17025 and trials are in progress to meet EU MRL for Dioxin and furane in fishery.

Title: **Development of Indigenous Technology for Up-gradation of Produced Raw Gas by (PCSIR Fabricated Biogas Plant) for Quantification and Purification of Bio-methane**

Project Leader: Razia Begum

Project Associates: Tooba Naveed Naiz Ahmed

Study Consultant: Alia Bano Munshi

Year of Initiation: 2013

Duration: 02 years

Background:

Raw biogas produced from anaerobic digestion is roughly 60% methane and 29% CO with trace elements of H_2S, and is not high quality enough to be used as fuel gas for machinery. The corrosive nature of H_2S alone is enough to destroy the internals of a plant. The solution is the use of biogas upgrading or purification processes whereby contaminants in the raw biogas stream are absorbed or scrubbed, leaving more methane per unit volume of gas is known as bio-methane.

Biomethane can be produced cheaply, cleanest biofuel and easily from any type of organic waste at all, including sewage in the future and can be safely compressed for use in vehicles or injected into the gas grid and has a number of environmental benefits which make it a green source of energy. Biomethane produced by the anaerobic decomposition of organic waste, which is the result of the natural breakdown of organic matter. This raw or slightly pre-treated gas is called biogas, and can be used locally to produce electricity, heat, or both in a combined-cycle process. After further purification, the biogas becomes biomethane, 100% renewable energy of the same quality as natural gas, which can be used in vehicles or injected into the natural gas network. Biomethane contains a heat capacity of about 130 Btu/gallon, which is equivalent to about 1,000 Btu/scf.

Objectives:

- Advancement of techniques for the production of biomethane and utilization.
- To enhance the biogas production by using high potential biowaste from different sources through co-digestion process and purifying biogas.
- To replace the imported technology and to use indigenous resources for development of biomethane technology.
- To initiate and implement an advance technology for a biogas to biomethane network in Pakistan.
- Design, fabrication and installation of purifying equipment for the removal of contaminants in raw bio gas.

- To create awareness to rural/Urban/industrialist/business communities useful environmental friendly blue flame energy.

Project Status: To be continued

Title: **Studies on Nano Carbon Tubes in Waste Water Treatments**

Project Leader: Razia Begum

Project Associates: Tooba Naveed Niaz Ahmed

Study Consultant: Alia Bano Munshi

Year of Initiation: 2014

Duration: 02 years

Background:

Waste water discharge from domestic, industrial or agricultural sources encompasses a wide range of contaminants and has drawn major concern worldwide since they adversely affect the quality of water. These contaminants are highly toxic and carcinogenic and can result in accumulative poisoning, cancer and nervous system damage. Removal of these contaminants relies on the sorption behavior of a sorbent. The aim of this project is the applications of CNTs in waste water treatment, biotechnology, renewable energy and supercapacitors are explored and a proposal for green nano composite design that embraces the 3R (reduce, reuse and recycle) concept has also been carried. Nanotechnology is gaining greater use in water systems. It is envisaged as being particularly efficient for the above three key purposes: In recent years, there has been increasing interest in monitoring and controlling of pH. It has become an important aspect of many industrial wastewater treatment processes.

The over arching goal for the future of reclamation and re-use of water is to capture water directly from non-traditional sources such as industrial or municipal wastewaters and restore it to potable quality. Of all the water withdrawn from rivers, lakes and aquifers, the majority is returned to the environment. Agricultural and livestock users return the least at 30–40%, whereas industrial users return 80–90%, power generation returns considerably more at 95–98%, and public and municipal users return 75–85%.

Objectives:

- To Design and installation of a plant nano carbon tube at lab scale.

- To study trouble shooting on plant.
- To check the efficiency of the plant and analyse the sample at NEQ'S limit.
- Addressed a new effective developments through education and communication to stake holders.
- Economic impact assessment of the implementation of nano-water technologies through cost- effectiveness studies
- The environmental and social impacts of these technologies will also be measured.

Present Status: New Project

Title: **Development of Technology for Combustible Hydrocarbons from Plastic Waste Materials into Liquid Fuel**

Project Leader: Rauf A. Khan

Project Associates: Muhammad Hammad Khan Farrukh Hussain

Year of Initiation: 2013

Duration: 02 years

Background:

In the last few decades, plastic consumption has increased. Annual consumption of plastics in Western Europe is about 60 million tons, which results in about 23 million tons of plastics waste. The huge amount of plastic waste has a lot of environmental, management and aesthetic problems. This project is focused to convert waste plastic materials into liquid fuels. This fuel can be used as replacement of fossil fuel that is depleting very fast.

Objectives:

Convert the plastic waste materials into liquid fuel at lab scale and optimize the parameters of process before advancing to pilot scale.

Present Status:

Setting up the M.S. vessel to optimize the process at semi-pilot plant level

Achievements:

- Converted a small batch of plastic waste (2Kg) into combustible liquid.
- Separated and estimated the fractions named naphtha, gasoline, kerosene, diesel and wax in the raw combustible liquid.
- Publication (National/International): 01
- Patents registered (National/ International): 01

- Process Developed/ Leased out: 01
- Product Developed/Commercialized: 01

Targets for 2014-2015:

- Convert the plastic waste into liquid fuel by thermal Pyrolysis at lab scale.
- Test the process efficiency with varying parameters like temperature of reactor, nitrogen purging and type of plastic materials and time.
- Analyze the liquid fuels for their composition, impurities and heating value.
- Interact with industry to meet the energy needs of industry.

Title: **Fabrication of Water Filters for Toxic Removal Using Indigenous Raw Materials**

Project Leader: Saima Imad

Project Associates: Sanum Saleem Muhammad Tahir
Muhammad Ashraf

Year of Initiation: 2014

Duration: 02 years

Background:

Water pollution is a very serious issue. Most of the industries in Pakistan are located in or around major cities and are a key source of increasing pollution in natural streams, rivers as well as in Arabian Sea through discharge of toxic water. Many industries (tanneries, cement, textile, sugar cane etc.) are major source of toxic and heavy metal pollution introducer in water.

Heavy metals such as arsenic, lead, chromium, mercury etc. contaminate water supplies and severely compromise the health of people drinking the water. Even though some heavy metals, such as chromium, iron, copper etc. are biological important and needed in trace quantities but their high concentration make them toxic.

Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.

Presently filters are available in market, but they are very costly and not very efficient. It is essential these days to prepare efficient filters using indigenous raw materials, so they can be cheap and easily available.

Objectives:

- Preparation of water filters using different raw materials/chemicals.
- Performance checks of these filters.
- Studies of different parameters affect the performance of the fabricated filters.

Present Status:

- Literature survey preliminary studies have been done.

Title: **Monitoring the Efficiency of Existing Municipal Wastewater Treatment Plant of Islamabad and Proposing Solutions for the Problems/Complications**

Project Leader: Muhammad Tahseen Aslam

Project Associates: Hajra Masood M. Younis Kaleem

Year of Initiation: 2014

Duration: 01 Year

Background:

The Capital Development Authority has built a sewerage treatment plant in the Sector I-9. The said plant was completed in the year 2007 and is capable of treating 17 million gallons of municipal sewage coming from already inhibited 25 sectors of Islamabad. According to the original plans of the sewage treatment plants, the treated sewage water was to be discharged into Nullah Lai. The prime purpose of the treatment plant was to clean the environment of the city of Islamabad and Rawalpindi where the untreated sewage of Islamabad was flowing unchecked causing the catastrophic situation for the environment of both the cities.

The existing sewerage treatment plant of Islamabad was visited by the team of experts from NPSL. It was observed that different sections of the treatment plant were not working properly. It means that sewage is untreated or partially treated, into the receiving water body i.e. Nullah Lai. This effects the efficiency of the plant and ultimately contributes in polluting the environment. There is a need to monitor the efficiency of the Islamabad sewage treatment plant and to propose a better solution for the effective treatment of the urban wastewater.

Objectives:

- To analyze the influent and effluent of the existing wastewater treatment plant (WWTP) of Islamabad
- To determine the efficiency of different portions of the WWTP
- To propose different recommendations for the improvement of WWTP Islamabad.

Work Plan:

A meeting will be conducted with the Director of Islamabad Sewerage Treatment Plant and finalize all the matters related to project.

In the first quarter the samples from the inlet and outlet of the sewage treatment plant were collected by NPSL and analyzed in the accredited labs of NPSL. The sampling will be done according to the standard methods, to obtain the representative sample for the better and reliable results.

In the second quarter the samples from different sections (Gravel chamber, primary settling tanks, biological tanks, secondary settling tanks) of treatment plant were collected and analyzed in the NPSL accredited labs. In the next two quarters the solutions were recommended to the CDA to implement it at sewerage treatment plant for its better efficiency. After the implementation of solutions, the sewage of the treatment plant will be monitored regularly on monthly basis, to avoid any future complications / problems.

Achievement:

The renaissance survey has been done by the Project Leader and Associates.

Present Status: New project

FOOD

Title: **Culture of Microalgae for Neutraceutical and Aquaculture Products**

Project Leader: Razia Sultana

Project Associates: Wajeeha Ali Faisal Ameer
Mohammad Nasir

Year of Initiation: 2013

Duration: 02 years

Background:

Microalgae culture is one of the modern biotechnologies, now a days using in food and pharmaceutical industries and in aquatic feed, *Spirulina* has been hailed as a greatest super food on earth by WHO. It is a microscopic unbranched, filamentous blue-green alga, rich in protein, vitamins especially vitamin B12 and pro-vitamin A (beta-carotene), iron, essential amino acids, minerals and essential fatty acids like gamma linolenic acid (GLA). Demand is surging for specialty aquaculture feeds that increase growth rates and disease resistance for farmed fish and prawns.

For the last 35 years chlorella has been cultivated commercially as a health food and later as aquaculture feed. The most important substance for human health found in chlorella is β -1,3-Glucan, which is an active immunostimulator and reducer of blood lipids. *Chlorella* also has several bioactive compounds, have antitumor and anti-carcinogen effects along with fundamental health benefits.

Dunaliella is the natural β-carotene, widely distributed under three different categories: β-carotene extracts, *Dunaliella* powder for human use and dried *Dunaliella* for aquatic feeds to induce pigmentation in culture animals.

Objectives:

- Identification of *Spirulina, Chlorella and Dunaliella* up to the species level.
- Preparation and maintenance of primary and secondary cultures of microalgae for academic and applied research (for supply to other organizations, individuals).

- Large scale culture of *Spirulina*, *Chlorella* and *Dunalliella.*
- Product development (pigment extraction, food supplement, neutraceuticals).

Achievements:

- Primary and secondary cultures of *Chlorella, Spirulina* and *Dunelliella* microalage are maintained in the laboratory.
- Study on development of low cost media suitable for culture has been done.
- Various media formulations have been tried and optimal parameters for growth have been determined. Work has been conducted on harvesting and drying techniques.
- Proximate composition of microalage is done.
- Internship trainings on "Microalgae Culture and Maintenance" has been given to 3 students
- 50 kg of dried microalgae was supplied to students of NED University for final year project.

Publication Submitted:

Growth aspect of Spirulina major on modified Zarrook's media, W. Ali, R. Sultana, K. Jamil, submitted online *Turkish Journal of Fisheries and Aquatic Sciences.*

Present Status: To be continued

Targets for 2014-2015:

- Large scale culture of *Spirulina*, *Chlorella* and *Dunalliella*.
- Studies on harvesting and drying techniques (freeze drying and spray drying).
- Product development.

Title: **Development of Functional Dietary Fiber from Fruit Processing Waste**

Project Leader: M. Samee Haider

Project Associates:

Omer Mukhtar Tarar	Umed Ali Soomro
Nida Saleem	Asadullah
Waqas Afzal	M. Rauf

Date of Initiation: 2014

Duration: 01 Year

Background:

It has been a challenging task world over to make cost effective and quality food products. Many countries are utilizing their available resources at an optimal level and producing by products from the fruit wastes using innovative and simple technologies. Pakistan is an agro-based country, moving towards the strengthening of economy associated with food industries.

After processing fruit into juice or juice concentrate, the left over material is discarded causing environmental pollution. Since, the left over material is part of the fruit; it has potential for conversion into edible by products. Different fruit processing industries generate huge amount of wastes that can be utilized to obtain useful components. Apples and mangoes are good sources of fiber with a well balanced proportion between soluble and insoluble fraction. Keeping in view the above prospects project is designed to utilize fruit wastes to develop functional foods like dietary fiber using innovative food processing.

Objectives:

- Development of cost effective value added ingredient/dietary fiber from fruit waste.
- To develop indigenous technologies for functional dietary fiber with the waste utilization.
- To uplift socioeconomic conditions of the country.

Present Status: New Project

Targets for 2014-2015:

- Development of dietary fiber as an ingredient from apple pomace and mango waste.
- To develop fiber from apple/mango residues and evaluate its functional properties, in order to use it as a potential fiber source in the enrichment of foods.

Title: **Technology Development for Low Cost Ethylene Ripening of Climacteric Fruits**

Project Leader: Omer Mukhtar Tarar

Project Associates:

Muhammad Rauf	M. Samee Haider
Arif Karim	Nabeela Dar
Umed Ali Soomro	Nida Saleem
Faisal	Lakht-e-Zehra

Year of Initiation: 2014

Duration: 01 Year

Background:

Mango is the fruit abundantly produced in Pakistan. It falls in climacteric category i.e. fruits which ripen after harvest. It is known that application of exogenous ethylene initiates the ripening process of mangoes. Effectiveness of this treatment is dependent on ethylene concentration, exposure time and maturity stage at harvest. However in Pakistan use of hazardous calcium carbide is popular among traders for ripening of mangoes. This practice has been banned by authorities in neighbor countries. It is the time to take initiative and introduce nature resembling ethylene ripening for mangoes. An important aspect of this is ethylene generator development to use for ethylene ripening of fruits. The available generators in Pakistan are all imported one and require the specific supplies to work with. It is envisaged that a prototype developed at this lab can then be replicated and supplied for market needs. The supplies i.e. liquid input solution for ethylene production can also be developed locally to replace the imported material. Moreover the research needs to finalize the ripening conditions for indigenous mango varieties are required to be addressed at this lab. Therefore this project of great national interest has been proposed and designed.

Objectives:

- Development of ethylene generator and its performance optimization.
- Development of input solution from indigenous resources.
- Development of proto-type low cost ripening chamber.
- Optimization of process conditions.
- Extension activity for promotion of the technology.

Present Status: New Project

Targets for 2014-2015:

- Development of an ethylene generator at PCSIR.
- Optimization of the performance of ethylene generator.
- Development of the liquid solution as input raw material for ethylene production.
- Development of proto type low cost ripening chamber.
- Optimization of conditions for ripening of local varieties.

Title: **Reduction and Control of Aflatoxins in Cereals and Grains by Ozonation Process**

Project Leader: Javed Iqbal

Project Associates: Aftab Ahmed Muhammad Asif Asghar

Year of Initiation: 2014

Duration: 02 years

Background:

Mycotoxins are naturally occurring poisonous substances produced by numerous moulds and fungi under favorable environmental conditions. Mycotoxins are most likely to infect agricultural, food and feed commodities. Aflatoxins are carcinogenic, mutagenic, nephrotoxic, hepatotoxic, teratogenic and immunosuppressive. Fungal infestation and subsequent contamination of mycotoxins in agricultural produce can take place along the entire supply chain i.e., farming , transportation, processing and storage. Within mycotoxins, aflatoxins are group of chemically allied resultant metabolites produced by fungi *Aspergillus flavus* and *Asp. Parasiticus.*

These deleterious fungal metabolites are also assigned by the International Agency for Research on Cancer as first class carcinogens. Aflatoxins in particular and other mycotoxins in general create potential threat to the health and performance of humans and animals. In the light of above mentioned facts it is planned to develop new effective methods for the removal/ destruction or detoxification of mycotoxins in cereals and grains and to help in increasing revenue for exporter and importer thus provide safer products to the consumers in or abroad the country. Detoxified commodities can be exported to many countries as value added products.

Objectives:

- To focus on the detoxification of aflatoxins and other mycotoxins by ozone treatment in food, feed and agricultural commodities.
- To assure that nutrients in the food and feeds are not destroyed by the ozonation processes.
- To evaluate the formation and distribution of ozone-aflatoxin and ozone-corn reaction products.

- To provide guidelines to the local farmers, food and feed industry, exporter, etc. in identifying the problem created by aflatoxins and other mycotoxins.

Present Status: New Project

Targets for 2014-2015:

- Establishment of technology for the detoxification/destruction of aflatoxins B_1, G_1, B_2 and G_2 with ozone in selected grains and cereals and to confirm by high performance liquid chromatography (HPLC) and thin-layer chromatography (TLC) techniques.
- The source of Ozone for the detoxification of aflatoxins and other mycotoxins will be use to study the elimination of aflatoxins/mycotoxins in grain and cereal.
- The effects of the ozonation process on nutrients, specifically lipids and proteins, in the grain and cereal products will be determined.
- The time of ozonation and ozone concentration, will be adjusted as per initial level of contamination to minimize nutrient loss.

Title: **The Mycotoxicological and Nutritional Viability of Detoxified Cottonseed Cake on Dairy Cattle**

Project Leader: Aftab Ahmed

Project Associates: Javed Iqbal Muhammad Asif Asghar

Year of Initiation: 2013

Duration: 02 years

Background:

Cottonseed cake is an excellent protein supplement (average 41 percent protein) and is used in cattle feed to yield high milk production.The nutritionally poor diets can lower food intake in milk producing animals and even may not grow or lactate properly. Nutritionally viable feed is required to get the best performance from the livestock. It is very unfortunate that the humid conditions throughout the country prevailed. As a result of this, food, feed, and their ingredients are prone to fungal attack.

Aflatoxin-contaminated cottonseed cake not only reduces animal performance and overall health, but it also creates risks of residues in milk. Aflatoxins is secreted into milk in the form of

aflatoxin M1 with residues approximately equal to 1 to 2 percent (1.7 percent average) of the dietary level. This ratio is not influenced greatly by milk production level since higher producing cows consume more feed and have a slightly higher transmission rate. Due to risks of aflatoxins residues in milk, dietary aflatoxins should be kept below 25 ppb.

In light of above mentioned facts it is earnestly required to get the feed and its ingredients detoxify and assess the nutritional value of cottonseed cake before and after detoxification. The food and feed safety laboratory has established detoxification process for cottonseed cake as well as other feed ingredients. Further to strengthen the technical and economical viability of the process there is need to assess the toxicological and nutritive value of cottonseed cake before and after detoxification.

Objectives:

- To destroy the carcinogenic residues, fungal spores, mycelia or to inactivate the aflatoxins as these fungal toxins could proliferate and can produce new toxins under favorable conditions.
- To preserve the nutritive value of the cottonseed cake and to enhance the acceptability by detoxifying the product.
- To enhance the nutritional values of Cottonseed cake by using ammonia detoxification technology.
- To provide awareness to the farmers and growers for ammonia detoxification as an industrial process.

Present Status: New Project

Targets for 2014-2015:

- Survey for the samples of cottonseed cake to evaluate the mycotoxicological and nutritional values before detoxification.
- Detoxification of samples through ammonia detoxification process.
- Re-evaluation of the detoxified cottonseed cake for the nutrition values.
- Evaluation of efficiency of detoxification process in the nutrition viability of cottonseed cake.

Title: **Development and Commercialization of Biological Control Technology for Aflatoxins Reduction in Agricultural Commodities of Pakistan**

Project Leader: Javed Iqbal

Project Associates: Muhammad Asif Asghar Abdul Basit Khan

Year of Initiation: 2014

Duration: 02 years

Background:

Mycotoxins are diverse group of substances numbering as many as 300 produced by fungal moulds that contaminate various agricultural commodities either before, after or during harvesting. However, the five most important ones comprise ochratoxins, deoxynivalenol, zearalenone, fumonisins and aflatoxins. Food quality and safety issues resulting from aflatoxin contamination presents a serious obstacle to programs designed to improve nutritional viability and enhancing the agricultural production that enable small farmers to establish link with the markets. Aflatoxins are highly toxic, cancer-causing fungal chemicals that suppress the immune system, retard growth, cause liver disease and lethal for both humans and domestic animals. Aflatoxin exposure thus provides a challenge to efforts undertaken to improve people's health, especially women and children.

This technology is particularly effective in the Asian context particularly Pakistan because it controls the source of aflatoxin, the fungus in the soil before it can contaminate the crop prior to harvest. Adapting and applying this solution to address aflatoxin contamination in Pakistan could dramatically improve the health and livelihoods of millions of families while reducing commodity losses due to contamination. Adoption of this biological control technology with other management practices by farmers will reduce aflatoxin contamination by >70% in grains and cereals, increase crop value by at least 70%, and improve the health of the people of Pakistan.

Objectives:

- To develop ready to use cost-effective, biological control technology for aflatoxin, in combination with other practices that will improve public health, increase agricultural trade, augment small stake holder's income, and enhance food security.

- To enable the commercialization of the biological control product in Pakistan and the identification of biological control strains for registration in Pakistan.

Present Status: New Project

Targets for 2014-15:

- To evaluate the potential of two non-aflatoxigenic *Aspergillus* strains, in reducing aflatoxin contamination in grains and cereals grown in Pakistan.
- Grain and soil samples will be collected from different location in Pakistan. The single spore of the *A flavus* type will be isolated from the grain and soil samples. All the isolates will be characterized for diversity in *Aspergillus* and composition of strains in the grain and the soil.
- Protocol will be developed and reproduced to screen the large number of *Aspergillus* isolates to identify atoxigenic strains.
- The fermentation, extraction of aflatoxin, and qualitative toxin estimation will be done on TLC, HPLC and PCR to identify putative atoxigenics. The large-scale fermentation of putative atoxigenics will be followed by extraction and estimation of the toxin. Isolates that do not produce aflatoxin will be considered as confirmed atoxigenics and will be subjected to further evaluation on the basis of their sporulation characteristics.
- Good tester mutant pairs will be developed from atoxigenic strains. These testers will be used to determine the uniqueness of each atoxigenic isolate. The testers will be useful to track population structure of strains after field release.
- Cereals and grains crops in a lab. and/or field trial (if possible) will be inoculated to test the competitive ability of atoxigen inoculated alone and together with a strong toxin producer.

Title: **Production of Biofertilizer For Agriculture Exploitation**

Project Leader: Quratulain Syed

Project Associates: Muhammad Nadeem, Rubina Nelofer, Sania Mazhar, Yasar Salim, Abad Ali Nadeem, Ammara Hassan

Year of Initiation: January, 2012

Duration: 03 years

Background:

Agriculture is heavily dependent on chemical fertilizers and pesticide to achieve higher yield in thrust of more profit gain and to meet the current demand. This dependence is associated with problems such as environmental pollution, health hazards, interruption of natural ecological nutrient cycling and destruction of biological communities that otherwise support crop production. Hence, crop production, pest and disease management have to be achieved in shorter intervals of time with fewer detrimental inputs. The use of bioresources to replace chemical fertilizers and pesticides is growing. In this context, plant growth promoting rhizomicro-organisms are often novel and potential tools to provide substantial benefits to agriculture.

Plant growth promoting rhizomicroorganisms are free living organisms that have beneficial effects on plant. They enhance soil fertility by increasing the amount of available nitrogen and phosphorus and other plant nutrients and synthesize several different phytohormones that can act to enhance various stages of plant growth and also suppress soil borne pathogens by antagonizing them. In recent years, the concept of PGPR mediated plant growth promotion is gaining worldwide importance and acceptance.

Objectives:

- Isolation and characterization of Nitrogen fixers (*Rhizobium*, *Azotobactor* spp., *Azospirilum* spp. etc.) and Phosphorus solubilizing microorganism (PSM) etc.
- Shake flask studies to develop inoculants of each bacterium and measured the efficiency characters.
- Selection of suitable and economical carrier materials for the production of solid inoculant.

- Production of Biofertilizer at pilot scale.
- Field trials in collaboration with Biofertilizer company to evaluate Biofertilizer efficiency.

Achievements (Product developed/commercialized):

- MOU signed;
  - MOU for the production of bio-inoculants of cost 0.1 Million Rs. has been signed with BIS Plus Pvt Ltd on 10-01-2011.
  - MOU of cost 1 Million Rs. has been signed with BIS Plus Pvt Ltd for bio-inoculant production on 09-11-2012.
- Research articles;
  - Quratulain Syed, M. Nadeem, Rubina Nelofer, Yasir salim, Sanina Mazhar and Ammara Hassan. 2013. Isolation and identification of *Azotobacter* strains from different soil samples and their comparison for nitrogen assimilation (Submitted).
  - Quratulain Syed, M. Nadeem, Rubina Nelofer, Yasir Salim, Sanina Mazhar and Ammara Hassan. 2013. Stability studies of *Azotobacter* spp., viability in solid and liquid based carries (Submitted).
  - Quratulain Syed, Rubina Nelofer, M. Nadeem, Yasir Salim, Sanina Mazhar and Ammara Hassan. 2013. Isolation, identification and characterization of phosphorus solubilizing fungus from soil (Submitted).

Present Status: To be continued

Targets for 2014-2015:

- Selection of suitable carrier material.
- Stability studies for shelf life evaluation.
- Scale up studies large scale production with maximum number of viable cells.
- Field trial for evaluation of biofertilizer efficiency.

Title: **Development and Standardization of Test Method for Identification of Cold and Slaughtered Meat**

Project Leader: Khurram Shahzad

Project Associates: Shaista Nawaz Salman Saeed

Year of Initiation: 2013

Duration: 02 years

Background:

Meat is highly nutritious due to high quality protein and is in great demand throughout the world. It is obtained by slaughtering the healthy live animals (halal meat). Halal is a Quranic term which means allowed or lawful where as haram is a Quranic term which means prohibited or unlawful. Consuming halal is an order of Allah and an essential part of the Islamic faith while haram is forbidden for every Muslim. Allah has repeatedly emphasized the consumption of Halal in The Holy Quran like "He only prohibits for you dead animals, blood, the meat of pigs, and food which is dedicated to other than GOD. If one is forced (to eat these), without being deliberate or malicious, then GOD is forgiver, Most Merciful. (Holy Quran 16:115)". The Prophet (S) has said: Allah (SWT) calls for mercy in everything. So be merciful when you slaughter; sharpen your blade to relieve its pain.

Moreover, cold slaughtered meat is considered to be unfit as it can pose health problems to the consumer depending on the cause of death of the animal. If it is due to infection or disease, the consumer will be at risk by consuming such meat containing harmful organisms, its toxins.

Therefore, differentiation of halal slaughtered meat from that of cold slaughtered animal or dead meat is of particular importance in Islamic as well as public health perspectives as prevailing unregulated marketing practices have resulted in many incidences where dead meat had been sold out to public.

Objectives:

Consuming Halal is an order of Allah and an essential part of the Islamic faith. The main objective of this project is to develop an authenticated and standardized method to rapidly identify the Halal slaughtered meat from the cold/dead one.

Achievements (till June 2013):

- Literature survey and selection of suitable method.
- Method developed for identification of live and cold chicken meat samples.

Present Status: To be continued

Targets for 2014-15:

- Method standardization/validation for chicken meat samples (30 live and cold meat samples).
- Trials for cold and live beef and mutton meat samples and method validation to develop standard test protocol (subject to the availability of dead meat).

Title: **Biosynthetic Pathway and the Appearance of Anthocyanins in Small Tropical Fruits of Nutraceutical Significance Grown in Pakistan**

Project Leader: Asma Saeed

Project Associates: Muhammad Iqbal Shabana Kauser
Nida Jamil Sidiqqui

Year of Initiation: June, 2012

Duration: 03 years

Background:

Several small fruits are known to have nutraceutical significance, which have been traditionally used as therapeutic agents on account of their pharmacological potential, in the treatment of cancer, liver-malfunctioning, high blood pressure, cardiovascular diseases, etc., also having anti-fever and diuretic attributes. Due to the presence of high amounts of some bioactive/ polyphenolic compounds, these fruits are reported to have antioxidant activities. Among the various classes of these bioactive compounds, the chemical class of anthocyanins is most relevant. Anthocyanins, belonging to the chemical family of flavonoids, impart attractive colourations to the ripe fruits, ranging from salmon pink through bright red, purple/violet, blue to nearly black. Anthocyanins thus also enhance the qualitative value and freshness of the mature fruits. Among such small fruits, grown in Pakistan, are *Syzygium cumini* (jamun) of the family Myrtaceae, *Grewia asiatica* (falsa) of the family Malvaceae, and *Morus nigra*, *M. macroura* and *M. alba* (kalla-toot/black-mulberry, Pakistan-mulberry/ Himalayan-mulberry and safaid-toot/white-mulberry, respectively) of the family Moraceae. These are traditionally used for their several health benefits, as documented in the folklore medicine and ethnobotany. These fruits have very short fruiting season, are highly perishable, and have small shelf-life. As such, people remain deprived of their consumption for the desired longer periods and during off-seasons. The present study aims to elucidate the scientific basis for their health benefits as known in the folklores and myths. For this purpose, these fruits were investigated for the identification,

characterization, and quantification of anthocyanins, specifically with reference to their respective biosynthetic pathways. Most of the reported studies are limited to the presence of anthocyanins in fruits at their maturity stage, with no information related to their appearance at various developmental stages. As such, the anthocyanin profiles, at different fruit maturation stages and their pattern of appearance in these fruits, are not known. This basic information is necessary to elucidate the anthocyanin biosynthetic pathways, and for identification/ characterization of different anthocyanin(s) appearing at the various stages of fruit maturation. Such a study is expected to be helpful to the growers for developing a fruit-harvesting protocol at the appropriate stage of maturity, in terms of their best nutritional value and the presence of the desired anthocyanin-cum-sugar profile. The study is further expected to open new vistas for the development of a modified atmosphere packaging system for the purpose of extending shelf-life of these fruits and for enhancing their worldwide market demand, and for generating new commercial opportunities for the growers and exporters.

Objectives:

- Antioxidant activity and the appearance of anthocyanins at different stages of the fruit development and repining stages of Falsa (*Grewia asiatica*), Jamun (*Eugenia jambolana*) and Shah-tut black (*Morus nigra*) have never been explored and investigated.
- The present study aims to characterize, identify and quantify anthocyanin profile of these seasonal small fruits, appearing at different stages of their maturity.
- The proposed work will be additionally helpful for the development of a preservation and packaging system for enhancing storage life of these seasonal small fruits and the retention of anthocyanins over longer periods of time with their nutraceutical characteristics intact. Knowledge of all these aspects is of value to scientists, growers and exporters.
- The data generated from the present research will characterize the presence of various classes of anthocyanins, such as cyanidin, delphinidin, malvidin, pelargonidin, peonidin and petunidin and their biosynthetic pathway, as also related with the attachment of sugar molecules with anthocyanins.

Present Status: To be continued

Targets 2014-2015:

- HPLC analysis of anthocyanins in selected fruits.
- Classification of anthocyanins.
- Characterization of anthocyanins.
- Quantification of anthocyanins.
- Sugar identification.
- Product development.

Title: **Development and Studies for the Efficacy of Locally Available Clays as Aflatoxin Binders in Animal Feeds**

Project Leader: Alim-un-Nisa

Project Associates: M. Khalid Saeed, Shamma Firdous, Salman Saeed, Sajila Hina

Year of Initiation: June 2014

Duration: 01 year

Background:

Mycotoxin contaminations occur world-wide and represent one of the most challenging and prominent food safety threats. Approximately 25% of the world crops are affected by mycotoxins annually. Livestock production is an important part of national economy and it plays a significant role in providing the high quality food for human beings. Livestock sector of Pakistan contributes up to 46.8% in the agriculture and about 10.8 of the GDP in the form of milk, milk products, meat, hides, skin and bone meal. Mycotoxin contamination is a health risk and highly toxic for livestock, poultry as well as for humans. Among Mycotoxins, aflatoxins have received greater attention than any of the other mycotoxins because of their demonstrated carcinogenic effects in susceptible animals and their acute toxic effects. Mycotoxins toxicity referred to as aflatoxicosis in animals range from chronic acute diseases leading to deaths.

Ingestion of Aflatoxin B1contaminated feeds in dairy animals can lead to secretion of its metabolite M1 in milk. Intake of milk containing even very low levels of aflatoxin M1 can cause liver damage and cancer, decreased abortion and immune suppression. Mycotoxin-absorbing agents bind dietary aflatoxins and reduce absorption from animal gastrointestinal tract as a result they protect animal from toxic effects of mycotoxins and reduce transfer of metabolite M1 in milk. The aim of the study is to investigate and identify various types of locally available clays and study their efficacy for the adsorption of aflatoxins in animal feeds.

Objectives:

- To investigate and identify various types of locally available clays and study their efficacy for the absorption of aflatoxins in animal feeds.
- To reduce the aflatoxin M1 levels in milk.
- To improve the health of livestock.

Status: New project

Title: **Conversion of Fruits and Vegetable Waste Into Bio Gas and Utilization of its Effluent as Bio Fertilizer**

Project Leader: Sakhawat Ali

Project Associates: Zahida Nasreen, Shumaila Usman, Ammara Yasmeen, Tehseen Yaseen

Year of Initiation: July 2013

Duration: 02 Years

Background:

Fruits and vegetables are more prone to spoilage than cereals due to their nature and composition, and this spoilage occurs at the time of harvesting, handling, transportation, storage, marketing and processing resulting in waste. Efficient management of these wastes can help in preserving vital nutrients of our foods and feeds, and bringing down the cost of production of processed foods, besides minimizing pollution hazards. According to agriculture department, 30% of vegetables/fruits are wasted due to negligence and lack of processing facilities. 25% of annual yield of fruits and vegetables (13.67 million tones) goes to waste.

Biogas produced is a term used throughout the world rather than methane gas to describe the fuel produced through anaerobic fermentation of manure and vegetable matter in digesters. Biogas is generally between 40 and 70 percent methane, with reminder consisting of carbon dioxide, hydrogen sulphide and other trace gases. The material drawn from anaerobic digestion called Sludge, or effluent, is a mix of solids suspended in a thick liquid. It is rich in nutrients (ammonia, phosphorus, potassium and more than a dozen trace elements) and is excellent soil conditioner. Thus, this effluent used as biofertilizer in preference to chemical fertilizer, offers economic and ecological benefits by way of soil health and fertility. As an agricultural fertilizer, instead of chemical fertilizer bio effluent can increase a field's net economic yield by 10-20% yield. This study aims at the production of biogas effluent using fruits and vegetables waste and its co digestion with buffalo dung in different ratios then to examine effects of utilizing digested effluent as biofertilizer by growing maize and barseen crops.

Objectives:

- To prepare biogas effluent through conventional method of anaerobic digestion using fruits and vegetable waste as a substrate co digested with buffalo dung using different ratios (50:50,60:40,75:25).
- To determine the biochemical analysis of fruits and vegetable waste sample before and after treatment, buffalo dung and digested effluent by standard AOAC method.
- To set a comparative evaluation of yield of maize and barseen crops using digested effluent as biofertilizer versus chemical fertilizer.
- To determine the soil analysis before and after application of biofertilizer and chemical fertilizer.

Work Plan:

Vegetable and fruit waste will be collected from fruits and vegetables market of Kot Lakhpat, Ferozepur road Lahore. The waste sample will mainly be comprised of rotten and raw form of potatoes, tomatoes, brinjal, onions, cucumber, bitter gourd, spinach, capsicum, green chilies, mangoes, apricot, plum, banana, melon and water melon. Also same amount of buffalo dung will be collected from the Gawala for producing biogas effluent. For growing crops of maize seed and barseen seeds will be procured from Punjab Seed Corporation. Pretreatment of substrate will be done by digestion of fresh waste, which ultimately increases methane yield. Then proximate analysis of vegetables and fruits waste will be done before and after treatment.

Biogas will be produced by following various steps. At start one digester will be loaded with buffalo dung while the other will be loaded with the mixture of fruits and vegetable waste and buffalo dung using different ratios((50:50,60:40,75:25). After assessing the quality and quantity of biogas produced from different combination ratios, the digested effluent will finally be utilized as biofertilizer for growing maize and barseen crops.

Present Status: New project

Targets 2014-15:

- Chemical analysis of waste before treatment.
- Production of Biogas by using waste.
- Chemical analysis of effluent.
- Application of prepared effluent as fertilizer to grow crops.
- Observation of crops growth rate.

Title: **Studies for Determination of the Ripening Stage of Mango Fruits for the Production of Mango Based Products**

Project Leader: Shaista Jabeen Khan

Project Associates: Nuzhat Habib Khan Muhammad Ashraf

Year of Initiation: 2014

Duration: 01 Year

Background:

The mango is one of the oldest tropical fruits. Mango is grown for more than 4000 years in Indian subcontinent. Dusheri, Katha, Anwar Rathor, Malda, Saroli, Sindhuri and Langra are some of the cultivars grown in Pakistan. It is a rich source of foreign exchange in the form of fresh fruits, puree, pulp and dehydrated mango slices also called mango candies.

Proper maturity of harvested fruits is essential both for fresh fruit sale and for its processing. At proper maturity the fruit is physiologically mature but unripe. Fruit picked at this stage ripens normally after harvest. Fruits picked too green does not ripen normally and develop shriveled skin, poor flavor, colour and aroma. Even use of artificial ripeners such as acetylene or ethylene only improve colour while flavour and aroma remains poor. These immature fruits often appear in the market early in the season and are thought to have contributed to the poor rating of early season mangoes by the consumers. However, harvest of over mature fruits is also not a good practice as fruits which are harvested too ripe cannot be stored or shipped satisfactorily. They may develop jelly seeds or softer fruit body. These over ripened fruits are more prone to damage by birds or handling during harvest/process/shipping. Over ripe fruits also disintegrate during slice cutting processing resulting in mushy, having a distinct overripe-flavored product.

The quality of an end product is inherited from the beginning of processing stating from the quality of the raw material. The quality of dehydrated mango slices also depends on the quality and maturity of the mango fruits used .The present study is planned to determine the effect of ripening stage of mango fruits (Langra & Sindhuri) pertaining to the quality attributes of the dehydrated mango slices.

Plan of Work:

- Physio-chemical Analysis of Mango fruits at various ripening stages.
- Physio-chemical Analysis of Mango fruits would be continued.
- Physicochemical analysis of dried mango slices.
- Analysis of the data to suggest the optimal maturity stage for the harvest.

Objectives:

To determine optimal ripening stage of mango fruits for dehydrated mango slices production.

Present Status: New project

Title: **Utilization and Evaluation of Feed Additives as Binders to Inactivate/Detoxify Mycotoxin and Mycoflora in Feed Stuffs**

Project Leader: Arshad Hussain

Project Associates: Salma Iman Javed Ali

Year of Initiation: 2013

Duration: 03 years

Background:

Mycotoxin produced by fungi is a major cause of hygiene problem. Aflatoxin contamination causes reduced feed quality and reduced animal/poultry efficiency either through poor conversion of nutrients or problems such as reproductive abnormalities. Aflatoxicosis in poultry causes restlessness, anorexia with lowered growth rate, poor feed utilization, decreased egg production and increased mortality. Pakistan is situated in subtropical region and its environment is conducive of mycotoxin production, it constitutes several contamination problems in agricultural produce throughout the world and has shown to be responsible for acute and chronic toxic effects in animals as well as in human beings. The problem of feed contaminated by mycotoxin and pathogenic fungal flora is of current concern and has received great deal of attention now-a- days .Increase in mycotoxin contamination of feed causes concerns among producers and consumers; hence the availability of reliable and feasible detoxification techniques for toxin and mycoflora free feed is essential.

Objectives:

- To inactivate or reduce highly toxic compounds for the safe guard of animal and human health.
- To make unusable contaminated feed into usable form and to restore the quality of agricultural produce.
- To improve the livestock wealth in Pakistan.

Present Status: New Project

Targets for 2014-2015:

- Determination of mycotoxin and fungal flora in different samples of feedstuffs.
- Testing and application of mycotoxin binders as feed additives.

Title: **Studies on Increasing Post Harvest Storage Life of different Fruits**

Project Leader: Shamsur Rehman Afridi

Project Associates: Muhammad Sohail, Rehmanullah Khan, Muhammad Arif

Year of Initiation: 2013

Duration: 03 Years

Background:

The post harvest quality of fresh fruits is of paramount importance for consumption and successful competition in the domestic and global market. However the maintenance of fruit quality demands constant vigilance because of their perishable nature. Fresh fruits continue to breathe or respire after they have been harvested. This process consumes oxygen and produces carbon dioxide and water vapors. The key to keeping these products fresh for as long as possible is to reduce the respiration rate without harming the quality of the product. The rate of respiration can be reduced by keeping the temperature low, having lower levels of oxygen and increased levels of carbon dioxide. The short post harvest life of fresh fruits is a major hurdle in marketing both at national and international levels. Unfortunately limited work has been done on extending shelf life of fresh fruits in Pakistan. So keeping in view the economic importance of the fruits and huge loss due to rot, this project is initiated. The purpose of this research work is to extend shelf life of fresh fruits using different physical and chemical techniques to find an economical and effective control measure to minimize the post harvest losses so that fruits can be shipped to distant markets and thus generate larger revenues for all stake holders. The results obtained will be highly useful for the farmers and fruit processing industries.

Objectives:

- To reduce the post harvest losses of different fruits.
- To develop cost effective processes and hence to extend the storage life of fruits.
- To provide alternate methods of fruits preservation and to reduce the economic losses for farmers and fruits processing industries.

Present Status: New Project

Targets for 2014-2015:

Perishable fruits such as peach, strawberry, litchi and apricot will be purchased from the local fruit market. They will be treated with different food grade chemicals and stored in different packaging materials so as to increase their post harvest storage life. Physicochemical and sensory evaluation will be carried out during the storage period.

Title: **Industrial Effluent Treatment through Ozonation**

Project Leader: Jehangir Shah

Project Associate: Inayatur Rehman

Year of Initiation: 2014

Duration: 02 years

Background:

The textile, paper, food processing and tanning industries have experienced significant economic development during the past two decades, accompanied by extremely high consumption of water. The textile industry produces large quantities of highly colored effluents, which are generally toxic and resistant to destruction by biological treatment methods. Most of the dyes used are of complex structured polymers. Particularly reactive azo dyes cause special environmental concern due to their degradation products such as aromatic amines which are highly carcinogenic. The use of a variety of dyes and auxiliary chemicals results in the discharge of toxic waste into natural water bodies. These industries are thus facing problems in maintaining a profitable level of production while reducing the intake of fresh water. Another problem is the disposal of large volumes of effluents which abides by environmental standards. These are generally not amenable to conventional biological, physical and chemical treatment processes due to their recalcitrant and complex nature. Advanced oxidation is a potential alternate method to decolorize and reduce recalcitrant wastewater loads from textile dyeing and finishing effluents. In the present project, Ozone gas will be provided at different dozes for the removal of COD, BOD from Industrial effluents. Besides, fungal contamination is the most common cause of spoilage of stored fruits and vegetables. Not only is that a problem but there is also the risk of microbial contamination increasing with longer storage periods.

Objectives:

- Preparation of small scale Ozone Generator.
- Removal of COD and BOD from waste water through ozonation.
- Enhancing shelf life of the fruits and vegetables through ozonation.

Present Status: New Project

Target for 2014-2015:

- A small scale Ozone generator at the Laboratory level will be prepared and after its successful preparation it shall be scaled up at pilot plant level.
- The self made ozone generator will be applied for the removal of COD/BOD and enhancing the shelf life of the fruits and vegetables.

Title: **Microbial Production of Pectinase by Fermentation**

Project Leader: Junaid Ahmed

Project Associates: Mujeeb ur Rahman Hassan Ullah

Year of Initiation: 2012

Duration: 03 years

Background:

Pectinase are the complex hydrolytic enzymes that degrade pectic polysaccharides and function as esterases and deploymerases. They include pectin esterases which catalyse the hydrolysis of methylated carboxylic ester groups in pectin into pectic acid and methanol, pectin lyases cleave (1, 4)-glycosidic linkages by trans elimination resulting in galacturonide with a double bond between C-4 and C-5 at the non reducing end and polygalacturonases hydrolyze the (1, 4)-glycosidic linkages in homogalacturonase.

Pectinases accounts for 10% of global industrial enzymes produced and their market is increasing day by day. These enzymes are used to facilitate extraction, filtration and clarification and to increases yields in the production of fruit juices and beverages. Pectinase is extensively used in food processing industry, souring of cotton, degumming of plant fibers, waste water treatment, vegetables oil extractions, tea and coffee fermentation, bleaching of paper and in the alcoholic beverage. In wine industry, pectinases are mainly used for decreasing astringency by solubilizing anthocyanins without leaching out procyadin polyphenols, and pectinases also increase

pigmentation by extracting more anthocyanins. Pectinolytic enzymes are naturally produced from many organisms like bacteria, fungi, yeasts, insects, nematodes, protozoan and plants. Microbial pectinases are important in the phytopathologic process, in plant-microbe symbiosis and in the decomposition of dead plant material, contributing to the natural carbon cycle. Pectinases are abundantly produced by saprophytic fungi. The decaying plant tissue represents the most common substrate for pectinase producing micro-organisms.

Keeping in view of the application of pectinase in various industrial processes, it is important to investigate the possibility of pectinase production by both solid substrate and submerged fermentation by locally isolated microbial cultures for industry.

Objectives:

- Development of low cost process for production of Pectinases.
- Utilization of agricultural by products for commercial scale production of Pectinases.

Achievements:

- 20 Fungal cultures have been isolated from soil and decaying fruit/vegetables and screened for Pectinase activity.
- A culture producing largest zone on screening media have been selected and preserved.
- Solid substrate fermentation on wheat bran by screened culture has produced 8 U/g of enzyme fermented broth.
- Further work for production of Pectinase is in progress.

Present Status: To be continued

Targets for 2014-2015:

- Further isolation of Microorganisms from various resources.
- Screening of those microorganisms for potent activity of Pectinase.
- Optimization of fermentation parameters for submerged as well as solid substrate fermentation.

GLASS & CERAMICS

Title: **Development of Alumina Ceramic Parts for Commercial Applications**

Project Leader: Fadia Shaheen

Project Associates: Bakht Bhadur Rana, Kashif Hamid, Muhammad Usman Alvi

Year of Initiation: March, 2012

Duration: 03 years

Background:

Alumina is a quite essential ceramic material, generally showing desirable mechanical, thermal, thermodynamically, electrical, diffusional, chemical and optical properties and is favorably cost effective for modern industry. The usefulness of alumina results from its high strength, melting temperature, abrasion resistance, optical transparency, and electric resistivity. More recent applications of alumina include catalyst substrate, tube of Arc lamps, and laser hosts. Possible new uses of alumina are in electronic circuits, optical components, alumina fibers for composite and biomaterials. Traditional uses of alumina are furnace components, cutting tools, bearings and gem stones.

Ceramic processing is a complicated and influenced by several factors. These factors can be grouped into mainly two categories. One is the processing condition and other is the intrinsic properties of raw materials. Processing conditions include temperature, pressure, and atmosphere and time whereas intrinsic properties encompass raw material purity, particle size distribution, morphology and surface area.

Objectives:

- Optimization of particle profile of alumina powders.
- Optimization of dopants and additives.
- Optimization of sinterability.
- Demonstration of alumina ceramics for textile and chemical industry.

Work Plan:

- Syntheses of fine alumina powders and evaluation of locally available alumina powder in the market.
- Reduction of particle size by mechanical and chemical means.
- Employment of various forming techniques.
- Drying and sintering of alumina ceramics.

- Characterization using DSC, TG, Dilaotmetery, XRD, SEM, etc.
- The finished alumina ceramic products will be presented.

Present Status: To be continued

LEATHER TECHNOLOGY

Title: **Development of Industrial Leather and the Technology for the Preparation of Gasket for High Pressure Jacks**

Project Leader: Dr Hafiz Rub Nawaz

Project Associates:

Barkat Ali Solangi	Uzma Nadeem
Beena Zehra	Muhammad Zeeshan
Raja Asad Ali	Farrukh Hassan

Year of Initiation: July, 2013

Duration: 02 years

Background:

Leather industry provides the necessities such as leather shoes and garments using byproduct of the meat industry. Since 1840 useage of leather for industrial application was introduced such as flat leather, belting leather for power transmission and round leather belt for industrial sewing Machines. Now a day's leather find it use in gasket, washers and special seal in automotive and marine industry. But unfortunately such types of leather are not prepared in Pakistan due to lack of standard technology. This type of leather is imported from European country specially from Germany at very high foreign exchange. Recently Pakistan Air Force has requested to develop this type of leather and the molding technology for hydraulic jack gasket. Therefore this project is to develop the demanding technology.

Objectives:

- Development of special type of leather with Hydrophobic and Oleophobic property to be used in seals and Gasket of Hydraulic Jacks.
- To save the huge amount of foreign exchange being spent on the import of such leather.

Present Status: New Project

Targets of 2014 – 2015:

- Research chemicals would be arranged from the local suppliers.
- Leather processing from raw to finish.
- Physical and chemical analysis would be performed.

Title: **Development of Techniques to Reduce/Remove the Ante-mortem and Post-mortem Defects in Leather Processing**

Project Leader: Farrukh Nazir

Project Associates: Ibrahim Hassny Farrukh Hassan
Muhammad Noushad

Year of Initiation: 2013

Duration: 03 Years

Background:

Technically / commercially, defective leather has minimum or approximately no demand in the International market because the articles fabricated from such leather, fetch less return. So there is need to work out on all relevant aspects of these type of leather for improving their value in terms of cost and consumption. The development of techniques will relate entire change in leather processing at pre finishing and main finishing stages. The major part of this investigation is to concentrate on finishing techniques for removing patches, faulty grain, scratches and poor pattern etc., while minor part of research is co - related with pre finishing techniques and raw materials to be treated for reducing looseness, low substance, fatty spew, Pin holes etc. Generally speaking the poorer the leather, the more complex treatment is required to obtain the good appearance and good felling of Leather etc. The systematic study of defective leather will provide a plenty of technical data which can be applied to improve the quality of leather and also minimize the monetary lost face by leather industry in each financial year due to defective raw material and faulty leather.

Objectives:

To reduce / remove the quantum of defects in skin/hide and also in wet blue leather through different techniques to minimize the wastage of leather due to various defects pertains to

Ante-mortem and Post-mortem problems, because very few skins and hides are found free from the defects and ultimately play worse effect on export potential.

Present Status: To be continued

Targets for 2014-2015:

- Collection of raw materials having infected diseases, inadequate substance and grain damage etc.
- Treatment of Ante-mortem defects / low quality of skin and hide (poor substance, loose skin, fatty skin, pin holes etc.) with multiple chemical processes up to crust leather to restore the condition of the materials.
- Remaining defects to be reduced in pre-finishing and finishing processes through special binders, waxes, pigments etc.
- Utilization of various mechanical operations such as Buffing, Toggling, Milling and Plating (with different patterns) for effective appearance.

MINERALS & METALLURGY

Title: **Recovery of Copper and Precious Metals from Electronic Waste (On Lab-Scale)**

Project Leader: Uzma Zafar

Project Associates: M. Arif Bhatti, Irfan Hafeez, Zahid Mahmood

Year of Initiation: 2014

Duration: 01 year

Background:

Electronic waste (E-waste) is the fastest growing waste stream and global concern in the industrial and urbanized world regarding potential environmental and health threats. However, recycling of e-waste through advance and conventional technologies is considered to be a profitable business as the used /end of life electronic equipment such as printed circuit boards PCBs of computers and mobiles contain copper and precious metals (Au, Ag, Pt and Pd) in recoverable amounts. In general wastes PCBs contain approximately 30% metals and 70% non-metals. It is therefore appropriate to device a holistic approach to manage and recycle the e-waste in self – sustained manner to save the environment and human health. PCBs recycling due to its complex composition require multidisciplinary approach.

General routes which may be followed for recycling comprise:

- Component recycling via disassembly.
- Metals recycling via mechanical processing, pyrometallurgy, hydrometallurgy and electrochemical-refining or a combination of these techniques.

This project is aimed to develop a suitable process to recover these metals from electronic equipments. The study includes physical separation of metallic parts from non-metals, followed by refining or extraction of metals by most economical technique.

Objectives:

From the use of renewable resources and environmental protection viewpoints, recycling of waste printed circuit boards (PCBs) receives wide concerns as the amounts of scrap PCBs increases dramatically. However, treatment for waste PCBs is a challenge due to the fact that PCBs are diverse and complex in terms of materials and components makeup as well as the

original equipment's manufacturing processes. Therefore, it is urgent to develop a proper recycle technology for waste PCBs.

Achievements:

- Chemical Evaluation of raw material for quantitative estimation of Copper, and Precious Metals (Au and Ag,) has been done.
- Smelting of metal parts (constitute largely Copper metal) has resulted in the form of blister copper (93%Cu and with other metals impurities including silver).
- Chemical evaluation of blister copper, after which hydrometallurgical and electrochemical processes are required for refining.

Targets for 2014-2015:

- Extraction of Copper from electronic waste leached solution by electro wining.
- Electro-Refining of Blister Copper.

Title: **Preparation and Testing of Non-explosive Demolition Agent with Improved Characteristic**

Project Leader: Shagufta Nasreen

Project Associates: Abdul Ghani, Mahtab Faisal, Nazir Jan, Sohail Noor, Amir Muhammad

Year of Initiation: 2012

Duration: 03 Years

Background:

Non-explosive demolition agents are commercial products that are an alternative to explosives in demolition, mining and quarrying. They offers many advantages including that they are silent and does not cause any explosion, ground vibration, gas, dust or any other environmental pollution when used, properly. They provide the most technically suitable and cost effective solution in restricted demolition of rock and concrete structure when near by structures most be protected from shock waves generated by explosives. In NWFP very few mine owners are importing and using this material for cracking mines while most people are not familiar with this

newly developed agent and are using the conventional explosive material which has been imported against a reasonable good amount of foreign exchange.

The non-explosive demolition agent has been prepared using indigenous lime stone and rice husk ash which when tested for breaking the ceramic and concrete bodies/blocks showed prominent results. However the time required to break the marble and granite blocks were some what higher then the reported one.

Objectives:

- Development of low cost non-explosive demolition agent from the abundantly available raw material.
- Introducing cost effective and safe technology in the country.
- Increase in the export earning of the country through the export of good quality (without cracks) granite and marble.

Achievements:

- Lab. scale process developed.
- Patent based on lab scale studies has been filed.

Present Status: To be continued

Targets for 2014-15

- Effect of particle size on the efficiency of the prepared demolition agent will be studied.
- Demolition agent will be prepared and tested for its efficiency from different raw materials.
- Efforts will also be made to reduce the time (42 hours) required for breaking the marble blocks.
- The prepared demolition agent will be tested in the field.

Title: **Development of Cementitious Composite from Minerals/Organic Wastes for Construction Industry**

Project Leader: Mahtab Faisal

Project Associates: Waheed ur Rehman, Shagufta Nasreen, Qazi Muhammad Sharif, Mehmood Iqbal, Pirzada Muhammad Naeem

Year of Initiation: 2014

Duration: 01 Year

Background:

Cementitious materials with variety of compositions and their respective applications as value added building material is the driving force for the scientists in the age of modern world. Portland cement is widely used as binding material in construction industry. The production of cement require huge amount of fuel energy for the clinkerization process at high temperature. There are some issues of grave concern like energy crises, heat insulation, emission of toxic gases during the processing of Portland cement which resulted in global warming. The dumping and decomposition of organic waste is also one the most important issue in Pakistan. As a matter of fact that recycling rate of organic waste is very low as compared to paper, glass and metals. These problems need to be addressed on top priority basis.

Beside processed gypsum, other types of mineral with binding properties will be utilized as a part of the blend for achieving superior physical properties. The experimental setup will be made to process inorganic/ organic blends for the development of desired products. The quality of the raw materials will be monitored by their characterization through state-of-the-art instruments. Organic waste material will be activated and followed by the incorporation into the inorganic matrix. The organic-inorganic composite material will be optimized through different experimental conditions and by varying proportions of organic-inorganic part in order to enhance adhesion, flexibility (plasticity), workability and non-slump etc. of the products followed by the evaluation through variety of physical testing parameters such as compressive strength, setting time, fineness, water absorption, specific gravity, thermal conductivity or insulation properties etc. The resultant material will be safe and with enhanced physical properties. This project will

be with substantial out come for building materials related to construction industry with low cost, low energy and involve simple blending procedures.

Objectives:

- To exploit the meaningful utilization of minerals and organic waste for the development of cementitious composite materials.
- To solve environmental problems, provide low energy and low cost technology.
- To encourage public and private sector investment in utilization of organic waste and mineral resources of the country.

Present Status: New Project

Targets:

- Collection of raw materials i.e. minerals and organic waste.
- Monitoring the qualities and processing of raw materials.
- Bench scale preparation of cementitious composite.
- Evaluation of the products through physical testing.
- Up-gradation of bench scale developed technology to semi pilot plant scale.
- Compilation of results and findings in the form of technical reports, research paper, patents, etc.
- Commercialization of the technology.

NANO TECHNOLOGY

Title: **Development of Nano-Composite Materials for Daily use Applications**

Project Leader: Muhammad Zia-ur-Rehman

Project Associate: Rabia Nazir

Year of Initiation: 2014

Duration: 01 Year

Background:

Globally, the market for nano-enabled materials is gaining attention and industry is being benefited by their multifarious aspects. Keeping this in view, a multidisciplinary project with its broad range applicability is initiated to help local industry to flourish in the field of nano-technology with focus on energy, agriculture, water treatment and catalysis.

Objectives:

- To help industry in implementation of industry-centric and application-driven projects based on nanotechnology.
- Self-sufficiency and self-reliability.
- Prepare value added products and materials.
- Technology transfer.
- Capacity building.

Achievements:

- Procurement of Reagents/Chemicals.
- Lab scale development of NPK composition [20:20:20] and its characterization.
- Preparation of Zeolite and its characterization.

Present Status: To be continued

Targets for 2014-2015:

Nano-Fertilizer	Nano-Filter
Conversion of NPK [20:20:20] to nano-composite as a slow release fertilizer	Development of nano-composite material
Development of NPK [10:10:10] and its conversion of NPK [20:20:20] to nano-composite as a slow release fertilizer	Characterization of nano-composite material
Field trials after characterization	Optimization studies for maximum efficacy of nano-composite material

PHARMACEUTICAL AND HERBAL MEDICINE/PRODUCTS

Title: **Isolation, Purification and Characterization of β-Galactosidase from Microbial Source**

Project Leader: Lubna Iqbal

Project Associates: Kauser Siddiqui, Saeeda Bano, Muhammad Saleem, Mehreen Akber, Kanwal Abbasi, Samina Iqbal

Year of Initiation: 2012

Duration: 03 Years

Background:

Lactose Intolerance is a deficit in the ability to digest Lactose and it is due to a relative lack of Lactase Enzyme. Dietary Lactose cannot be absorbed intact. It must be hydrolyzed into its constituents, glucose and galactose to allow the transport through the epithelium. Clinical signs of lactose intolerance are nausea, intestinal cramps, bloating, flatulence and diarrhea.

Objectives:

- To isolate and characterize the lactase enzyme from microbial source.
- To develop genetically modified strain for mass production of enzyme.
- To establish a plant for the production of enzyme.

Achievements:

- Seven different strains have been collected and characterized for the production of β-alactosidase enzyme from microbial source.
- Among these strains three have been selected for the better production of β-galactosidase.
- These selected strains are being optimized with all the biochemical parameters to yield maximum amount of enzyme β-galactosidase.

Present Status: To be continued

Targets for 2014-2015:

- Maximum yielding strains would be selected for the mass production of β-galactosidase.
- One formulation will be prepared by using this enzyme.
- Process would be leased out.

Title: **Synthesis of Heterocyclic Organic Compounds for Drug Development**

Project Leader: Shahnaz Perveen

Project Associates: Seema Iqbal, Kamran Ahmed Abro, Ghulam Fareed

Year of Initiation: July 2012

Duration: 03 Years

Background:

Synthesis of heterocyclic organic compounds and discovery of new lead molecules that is the synthesis and purification of a new compound with expected biological activity and therapeutic value. Pharmaceutical chemistry and drug designing constitutes one of the most important aspects of therapeutic disciplines. Enzyme inhibition is an important area of pharmaceutical research, since studies in this field have already led to the discovery of wide variety of drugs useful in a number of diseases. Specific inhibitors interact with enzymes and block their activity towards their corresponding natural substrates. Urea derivatives are an important class of organic compounds because they often display biological activity, and are widely used as agricultural pesticides, or as pharmaceutical, they are also the components of drugs including HIV protease inhibitors that are trypsin and α-chymotrypsin to CCK-β receptor and endothelin antagonist, scaffolds for the creation of artificial β-sheets and as peptide backbone mimetics, anti-ulcer and they are also reported as inhibitors of acetylcholinesterase, butylcholinesterase. Therefore comprehensive developments in these fields and search for new effective urease serine protease, acetylcholinesterase and butylcholinesterase etc inhibitors are still an urgent need for drug development. The heterocyclic

compounds also play a significant role in blood pressure and inflammation regulations and are potent and stable inhibitors of soluble epoxide hydrolase and exhibited strong hypotensive action and antiarrhythmic properties.

The available antidepressant medications have effectiveness and as well as adverse side effect is the subject of studies. The synthesized urea derivatives will also be tested for "anti-depressant" activity. Still more research is required for the innovation of novel antidepressant drugs with fewer side effects.

Objectives:

- Syntheses of 50-100 different urea derivatives, and heterocyclic compounds and to subject them for bio screening, enzyme inhibition, cytotoxic screening, sensitization, irritation or intra cutaneous reactivity and systematic toxicity.
- Submission of 1 or 2 compounds which have potent biological activity for animal trial in concern laboratories based on availability of funds.

Achievements:

- Ten heterocyclic organic compounds have been synthesized.
- 2% ophthalmic solution of HPMC (Hydroxypropyl methyl cellulose) has been prepared. This solution is used during eyes surgery and prepared on request of M/s. Ashraf Pharmaceuticals (Pvt.) Limited, Karachi.
- Project is approved on 12th March, 2013 by PSF (Pakistan Science Foundation) having project No. PSF/Res/P-PCSIR/Chem/478 entitled "Synthesis of Heterocyclic Organic Compounds for Drug Development". Approved allocation is 1.56612 million, but funds didn't release.
- Compounds are submitted for pharmacological activity i.e., enzyme inhibitions.

Present Status: To be continued

Targets for 2014-2015:

- Purchase of HPLC or GC-MS columns.
- Purchase of chemicals.
- Extensive literature search for feasible routes for the synthesis of urea derivatives have been completed. Some other methods will also be developed. On line literature will be carried out.
- Synthesis of new urea derivatives for the development of new drug candidates.
- Compounds will be submitted for pharmacological activity like enzyme inhibitions and anti-depressant.
- Fifty (50) heterocyclic organic compounds will be synthesized.
- Paper will be submitted.

Title: **Production of Probiotic for the Biotherapeutic and Nutritional Use**

Project Leader: Lubna Iqbal

Project Associates:

Kauser Siddiqui	Saeeda Bano
Muhammad Saleem	Mehreen Akber
Kanwal Abbasi	Samina Iqbal

Year of Initiation: 2013

Duration: 02 Years

Background:

Probiotic bacteria/yeast are defined as "live micro-organisms" which when administrated in adequate numbers confer a health benefit on the host. Probiotics are commonly found in the form of chilled fermented food, spray dried and lyophilized products but the demand for the biotherapeutic is mounting day by day. It works for;

- Improved growth rate by better utilization of food/ feed in human and animals
- Preventing colonization of harmful microorganisms in human and animal intestine.
- Relief of constipation and neutralization of entero toxins produced by pathogens.
- Antitumoral and Anticholesterolamic effect.
- Immunity inducer.

There are various probiotics which are imported in our country and used as biotherapeutic agent and as a feed supplements.

Objectives:

- Selection of biotherapeutic probiotic strains for human and animal use.
- Production of biotherapeutic products by using various techniques i.e fluidized bed dryer, spray dryer and lypholization.
- To develop an alternate remedy for prevention of diarrhea, mucosal immunity, urinary tract infection and ulcer due to *H. pylori* at an affordable price.
- To substitute imported / expensive probiotic.

Present Status: To be continued

Targets for 2014-2015:

- Probiotic strains of *Saccharomyces boulardii* and *Lactobacillus* bacteria will be isolated from marketed sample.
- Purification of isolated bacterial strains.
- Formulation of biotherapeutic product.
- Quality Control test of the biotherapeutic products would be carried out.
- Successful product will be patented.
- Procurement of microbial medium, chemical and anaerobic jar for anaerobic microorganism.
- Isolation and identification of probiotics stains.
- Development of cheap medium for probiotic strains.

Title: **Development of Facilities for the Detection of Performance Enhancer Drugs in Sportsman**

Project Leader: Shahnaz Perveen

Project Associates: Seema Iqbal, Kamran Ahmed Abro, Ghulam Fareed

Year of Initiation: July 2013

Duration: 03 Years

Background:

Anabolic Androgenic steroids AAS have got much attention by Anti-Doping Laboratories like World Anti-Doping Agency (WADA) as an abuse drug. Nandrolone and Testosterone acts as an anabolic and androgenic agents and target on the development of reproductive and non-reproductive tissues. These AAS have been reported to be endogenous in nature but administered orally or therapeutically for performance enhancing in athletes. Some of the prohormones like DHEA (Dehydroepiandrosterone), androstenedione and norandrostenedione are sold as nutritional supplement and have been claimed to be converted into active hormones and enhance the physiological effects like lean body mass, muscle strength and haemoglobin concentration.

However, exogenously administered T causes marked and characteristics changes in circulating concentration of Leutenizing Hormone (LH), 17α-Hydroxyprogesterone (17-OHP) and Epitestosterone and the pattern of steroids in urine like T/E, T/OHP and T/LH ratios. These ratios are sometimes challengeable due to natural and inter-individual variations. Another

approach of carbon isotope ratios $^{13}C/^{12}C$ is very useful for the determination of endogenous or exogenous origin of testosterone. Exogenous administration of testosterone is of pharmaceutical origin and is obtained by semi-synthesis from starting materials such as Diogenin and stigmasterol, which are derived from plants source. Plants have different fixation capability of ^{13}C as compared to animals and are therefore effective mean to determine exogenous administration.

Objectives:

- To develop Dope testing method / facility of International standards.
- To study the endogenous levels of testosterone, epitestosterone and T/E ratio of various sportsmen of Pakistan.
- To organize an awareness program to help the athletes and sportsmen/women.

Present Status: To be continued

Targets for 2014-2015:

- Sample collection and method development.
- Method identification through literature search, preferable technique will be LC-MS/MS, GC-MS and HPLC may also be used.
- Procurement of standards, chemicals and solvents.
- Meeting with sports officials.
- Strategy will be designed for volunteers; groups will be made, depending on age, area (location) type of sport etc.

Title: **Synthesis and Isolation of Bioactive Compounds and Development of Instrumental Bioassay Methods**

Project Leader: Aisha Nelofar

Project Associates: Salman Tariq Khan Abdul Hafeez Laghari

Year of Initiation: 2014

Duration: 03 year

Background:

The work is proposed to proceed in two phases.

Phase-1: Synthesis and Isolation of Bioactive Compounds

Synthesis:

Pyrrole-fused lactones and their derivatives are emerging class in the field of medicinal chemistry, and are present in a large number in nature as biologically active compounds.

The variety of pharmacological activities displayed by the core structure of this class greatly increased our interest. The naturally occurring Lukianols are very good representative example of Pyrrole-fused lactones. These compounds are found to be moderate anticancer agents, aldose reductase inhibitors (ARI) and weak anti-inflammatory and analgesic agents.

Isolation of Bioactive Compounds

Following species have been the selected to work out in this project for isolation of bioactive compounds:

Fagonia indica L., *Tecomella undulata, Cressa cretica* L., *Asphodelus tenuifolius* Cav., *Cassia angustifolia* Vahl., *Cassia holosericea* F. and *Cassia italica* M., *Erythrina indica.*

Although these species seem to have a great medicinal potential and the existing reported work about these species is still in most cases very limited regarding the isolation and bioactivity evaluation of natural products. It is justified in the sense that the plants beside the bioactive compounds also contain toxic substances and their usage as a whole plant material may be health hazard. It is world wide acceptable fact that the scope of isolated bioactive plant material especially

life saving drugs is very high and play a vital role in boosting up the economy of the country. Therefore, the present study will fulfill the criteria of the planned strategy and hopefully will produce a couple of patents in this regard.

Phase-2: Development of Instrumental Bioassay Methods

The conversion of early reported methods regarding any test or analysis by classical instruments to advance instrument has been choice in current scenario. It results authenticity, accuracy and sensitivity of methods which are developed by this way. Thus, currently the bioassay of synthesized as well as isolated bio-molecules is being done by using instrumental methods. In this approach different compounds are determined quantitavly using sophisticated instruments to evaluate the bioactivity because the variration in amount of such compounds during bioassay has direct co-relation with activity. For example, LC-MS/MS assay method to evaluate anti-inflammatory activity. This assay involves the use of intact cell system (platelets) as a source of COX-1 and 12-LOX enzymes and highly sensitive and specific LC–MS/MS technique for detection of main arachidonic acid metabolites formed by COX-1 and 12-LOX. Arachidonic acid is precursor to the eicosanoids which are physiologically and pharmacologically active compounds.

Objectives:

- The aim of this study will remain Designing and Synthesis of some new Pyrrole-fused lactones based chemical entities.
- The new chemical entities will be anticipatingly biologically active, mainly as potential drug candidates as a new anti-inflammatory and analgesics.
- New bioactive compounds will be isolated from natural sources.
- Development of facilities for Bioassay.

Present Status: New Project

Targets for 2014-2015:

- Literature survey.
- Purchase of chemicals/accessories.
- Lab scale synthesis of bio molecules.
- Isolation of bioactive compounds from plat source.
- Development of bioassay facility.

Title: **Synthesis of Triterpenes and other Bioactive Compounds by Microbial Biotransformation/Chemical Method for Cost Effective Drug Preparation. The Anti-oxidant and Related Biological Potential of the Isolated and Derivatised Metabolites**

Project Leaders: Nighat Sultana Zahra Yaqeen

Project Associates: Muhammed Saleem Qazi Rashid Ali khan
Mahmood-ul-Hassan Muhammad Ali Imran

Year of Initiation: 2014

Duration: 03 Years

Background:

Triterpenoids are a naturally occurring group of compounds. Several promising new triterpenes are in clinical development based on selective activity against cancer-related molecular targets.

Microbial transformations have been widely used in the production of several therapeutically important triterpenoids / bioactive compounds on commercial scale. This project deals with triterpenoids with antioxidant activity and related biological potential isolated from *A. scholaris* and other sources. During this project synthesis of triterpenes and other bioactive compounds will be carried out to get its metabolites with improved efficacy, such as longer duration of action, minimum side effects. So we can have the alternative drugs with least tolerance and good activity. Fungal, bacterial and yeasts are used as enzyme source. These metabolites can act as new drug molecules with improved safety, improved biological activity and efficacy. New bioactive drugs will be designed and synthesized by using biotransformation / synthesis methods. The pilot plant available in PCSIR Laboratories may be used to biotransform cheap starting material to active ingredients, which can be tried in the manufacture of high price medicines effective against various ailments. The drugs based on the active ingredient from cheap starting material may also act as analgesic, antipyretic, spermicidal and as insecticide. These triterpenes will be a cheap source of raw materials for drug development.

Objectives:

- To initiate process of drug discovery and development by using practical approach of biotransformation (structural transformation) of triterpenes.
- The main objective of biotransformation of triterpene is to synthesize new analogue of triterpene with improved efficacy.
- To develop new techniques and method for biotransformation of triterpene into its metabolites.
- To synthesize novel triterpene analogue which are less prone to resistance?
- To provide longer duration of action with minimum side effects.
- To reduce resistance to get better therapeutic profile.
- To establish hypothesis that metabolites can act as new drug molecules as well as can show the safety and efficacy.
- This project will also help to develop International skills of pharmaceutics for drug production in our labs.
- Compounds that act on the enzymes are receiving attention as potential therapeutic agents. Therefore new inhibitors of different diseases will be designed by using computer software and then will be isolated/synthesized for enzyme inhibition studies to target the required new drugs.

Targets 2014-2015:

- The most active and non-toxic natural/biotransformed and semi-synthetic compounds will be patented for potential commercial use and value addition. The active compounds will also subject to various stages of drug design/discovery investigations. According to their activity and economic importance.
- Development of biotransformation methods to determine the bioactive compounds.
- Development of therapeutic drugs from active compounds.
- To evaluate the therapeutic potentials of synthesized/biotransformed compounds and their comparison with the standard drugs in order to establish the potency in different disciplines of therapeutics.
- To achieve the above mentioned objectives, productive research collaboration will be established. This research collaboration will include exchange of senior scientists and joining bioprospective program targeted towards identification of potential therapeutic leads.

Title: **Phytochemical and Biological Studies of *Myrtus* Species**

Project Leader: Vaqar ul Hassan

Project Associates: Gul Akhtar Marwat Muhammad Qaisar
Inayat ur Rahman

Year of Initiation: 2014

Duration: 02 years

Background:

Callistemon lanceolata and *Myrtus communis* belongs to family Myretacea and genus Melaleuca, which has been proved since decades a good source of cajuput oil and recently a source of betulinic acid (triterpene). The cajupat oil is used in Rheumatism, muscular cramps and healing of wounds. It also acts as insect repellent.

The constituents of *Myrtus* spp. namely Myrtucommulone and semi Myrtucommulone are reported to have anticancer activity which act via apoptosis like betulinic acid. Myrtucommulone and semimyrtucommulone are also reported as an effective antimutegenic principle and various research articles have been documented in this regard.

It is also known that different extracts of said species have found to possess anti oxident, bacterilcidal and fungicidal activities. Moreover these bacterial fungicidal constituents also reported to exhibit anti inflammatory potential thus supporting their therapeutic use in inflammation and allergy disorders.

In the light of above mentioned facts, the plant posses valuable phytoconstituent. Based on the biological activities, the phytoconsitutents of these species need further work to fully explore its potential.

Objectives:

- To identify the biologically active extracts /fractions.
- To isolate the constituents of biologically active extracts/fractions.
- To identify the presence of myrtuscommulone in different fractions for the treatment of diseases related to mutagenesis, inflammation and allergy.
- To report the data in reputed journals/patent.

Present Status: New Project

Targets for 2014-2015:

- Identification of isolated constituents/ class of compounds.
- Spectral and physical constant determination of each component.

Title: **Preparation and Utilization of *Opuntia* Extracts in Herbal Products**

Project Leader: Mushtaq Ahmad

Project Associates: Humaira Inayat S. Naeemuddin Gillani

Year of Initiation: 2014

Duration: 01 year

Background:

The plants belonging to *Opuntia* genus are succulent shrubs of Western countries, which have been naturalized widely to the warmer regions of world including Pakistan. *Opuntia* species are rich source of dietary fibers, natural colourants and antioxidant vitamins and therefore used as a food and fodder. It is because of their reddish-purple, fleshy edible fruit that they are known in vernacular as prickly pears.

In folkloric system of medicine *Opuntia* is considered as a good remedy for bronchial asthma, whooping and spasmodic cough, indigestion, hepatic congestion. Polysaccharides of *Opuntia* cladode might be responsible for these beneficial properties. The fruits of *Opuntia* species (prickly pears) are rich in betanin and isobetanin, quercetin and its glycosides as flavonols. They are considered a better source of food colorants.

Pharmacological evaluation of *Opuntia* has shown its efficacy as antihyperlipidemic, antiviral, anti-inflammatory, anti-diabetic, antioxidant and anti-ulcerogenic agent. It has also been reported to protect nerve cells and used for the treatment of Alzheimer's disease, Parkinson's disease and stroke. So far, from some species potent hypotensive agents, analgesic, radical scavenging activity and anti-spermatogenic effect have been reported. Although traditionally used as a valuable health supporting nutrient, the vegetative parts of *Opuntia* spp. plants are scarcely used in modern nutrition and medicine.

Objectives:

- Preparation of standardized extracts of *Opuntia* spp.
- Extraction and isolation of chemical constituents.
- Investigating the pharmacological activities including anti-oxidant, anti-diabetic, anti-cholesterolemic, anti-microbial, hypotensive and toxicity etc.

Present Status: New Project

Targets:

Collection, extraction, isolation, characterization, pharmacological activities and standardization of the plant extracts.

SOLID FUEL AND ALTERNATIVE ENERGY

Title: **Preparation and Characterization of Liquid Fuels from Renewable Resources**

Project Leader: Mahboob Ali Kalhoro

Project Associates: Amanat Ali, Muhammad Arman, Gul-e-Rana Jafferi

Year of Initiation: 2013

Duration: 03 Years

Background:

Bio-fuel production from renewable resources is widely considered to be one of the most sustainable alternatives to petroleum sourced fuels and a viable means for environmental and economic sustainability. Bio-fuels are the types of fuels that are derived from biological carbon fixation. Bio-fuels include the fuels derived from biomasses and other natural and agricultural resources likewise vegetable oil, animal fat and other agricultural and algal sources. Fossil fuels are not included in bio-fuels because they contain carbon that has been out of carbon cycle.

Ethanol bio-fuels:

Since Pakistan is an agricultural country and various crops are cultivated for food and other purposes. Pakistan is seventh largest sugar cane producing country; sugar cane is used to obtain sugar and ethanol as a by-product. Ethanol has potential to be used as fuels or can be blend to fossil fuels upto 15% for increasing octane number and to reduce the fuel prices and it also decreases the emissions from engines.

Bio-diesel:

Biodiesel refers to a vegetable oil or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, propyl or ethyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g. vegetable oil, animal fat (tallow) with an alcohol.

Algal bio-fuels:

Algae Biodiesel is a good replacement for standard crop Biodiesels like soy and canola. Up to 70% of algae biomass is usable oils. Algae do not compete for land and space with other agricultural crops. Algae can survive in water of high salt content and use water that was previously deemed unusable.

Objectives

- Various composition blends of ethanol with liquid petroleum will be characterized.
- Attempts will be made for preparation of biodiesel from different sources and its characterization.
- Preparation and Characterization of Algal bio-fuels.

Present Status: Literature survey has been completed

Targets for 2014-2015:

- Preparation of various blends of ethanol with liquid petroleum.
- Characterization of biodiesel from agricultural and algal sources.

Title: **Thermodynamic Analysis of Release Alkali Species Under Pressurized Gasification and Combustion of Coal and Biomass**

Project Leader: Gul-e-Rana

Project Associate: Amanat Ali

Year of Initiation: 2013

Duration: 03 years

Background:

Coal is a major fossil fuel and playing increasing role for electricity generation but limitation of fossil fuel and rise in energy for next thirty years is required to installation of additional power plant to meet the crises of power generation.

Recently, coal based integrated gasification combined cycle power generation systems cycle has been considered as key technology for 21st century, which are developed or under development with aim to increase the efficiency of coal combustion and gasification, but it requires, a reliable gas cleaning to provide the gas turbines and prevent them to hot corrosion caused by molten Na-, Cl- and S- containing species.

Therefore, comprehensive knowledge of release alkalis is required prior to utilization of coal and biomass for power plants. Thermodynamic analysis is the base for obtaining such information and results are useful guidance for predicting trend occurring during pressurized combustion and gasification.

Objectives:

- To develop appropriate methods techniques for thermodynamic analysis of Na-,K-, Cl, and S- species under high pressure combustion and gasification.
- To provide detailed information about release behaviour of alkali species by performing combustion and gasification.
- To calculate amount of release species under pressurized combustion and gasification.

Present Status: Literature survey has been completed

Targets for 2014-15:

- Selection of different Pakistani coal and biomass.
- Proximate, Ultimate and Ash Analysis of coal and biomass samples.
- Perform combustion and gasification at different conditions of pressure.
- Determination of release behavior of alkali species released during and combustion and gasification.
- Estimate the amount of release alkali species from different Pakistani coal and biomass.

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