



# PCSIIR R&D

PROGRAMME  
2019--2020

PCSIIR R&D PROGRAMME 2019 - 2020



PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH



**PCSIR**  
**Research & Development**  
**Programme**  
**2019-2020**

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

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### **Shahida Begum**

Director SIC

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# Foreword

Research & Development (R&D) in the fields of Science & Technology is at the heart of a knowledge based economy. A major part of our economic activity now lies with the so-called knowledge Industries and Services sectors, which are primarily based on scientific processes and products.

The pivotal role of Science & Technology in National Development was realized soon after we gained independence. The establishment of research institutes through the endeavours of renowned scientists were manifestation of these recognition. Presently, Pakistan has a well developed network of research and development institutions and facilities, where multiple areas of scientific research are being catered. However, we need to address the issues of enhancing the quality of research as well as the need to make it more responsive to the needs of our industry, agriculture and other sectors.

Keeping in view the applicability of Science & Technology in every sphere of human development, Pakistan Council of Scientific & Industrial Research (PCSIR) is focusing to undertake demand driven research and strengthen their linkages with the industry as well as the academia, with the objective of resolving industrial problems and developing new technologies & products, also promote the innovations as well as the commercialization of the products and IP culture in the Country.

The present R&D programme of PCSIR is an outcome of interaction made with the relevant stakeholders (Chambers of Commerce & Industries, Sectors Specific Trade Associations, Industries, Academia & SMEs) through consultative meetings /Workshops & Seminars. In the year 2019-20, 12 number of Demand Driven R&D projects are being executed in different Laboratories/ Centres of PCSIR which are being funded through the Ministry of Science & Technology (MoST) as well as from PCSIR's Self Generated Funds (SGF). In addition, 121 in-house R&D projects are also being carried out with an aim to develop new processes and technologies to attain self-sustainability by the local industrial sector in the areas like Nano-technology, Bio-technology, Renewable Energy, Materials Science, Mineral Processing, Engineering, Pharmaceuticals, Medicinal Plants, Environment, Leather & Textile, Applied Chemistry, Applied Physics, Food & Marine Sciences, Glass & Ceramics etc.

Comments, views and suggestions are invited from all the stakeholders as it is now need of the time that we may fortify the result-oriented linkages amongst our R&D organizations, academia & industry in order to promote the innovation culture. This would need more resolute and coordinated efforts to generate a momentum towards need-based and technology driven research.

**(Habib Ullah Khan)**  
**Chairman**



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**Title:** **Development of Emamectin Benzoate - Potential Cotton Pest Herbicide**

**Project Leader:** Dr. Muhammad Zia-ur-Rehman, SSO

**Project Associates:** Dr. Rabia Nazir, SSO                      Mr. Mehroze Ahmad Khan, SO  
Ms. Shafaq Mubarak, SO

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

Cotton is one of the major crops of Pakistan, having vast utility in a number of textile products. Cotton production in Pakistan is integral to the economic development of the country and Pakistan falls at fourth position among the global producers of the cotton. Recently due to the pest infestation, reduction in growth of cotton is observed. To overcome this pest infestation, cotton industry relies heavily on pesticides and insecticides. Significant global pests for cotton include American boll worm, chilli thrips, tarnis plant bugs etc. To deal with the pests, a wide range of pesticides are being used. Majority of the pesticides either in terms of active ingredient / pesticides formulations are being imported resulting in huge investment in foreign exchange. To avoid this financial drift, its need to develop pesticides at local level. Cotton crop is more vulnerable, if we use American boll worm for Emamectin benzoate based pesticide formulation. Emamectin belongs to the abamectin family of compounds which is used for wide range of pests and anthrapods. This active compound Emamectin is not currently being synthesized in Pakistan. In order to avoid its import, there is a need to develop the methodology for the synthesis of Emamectin Benzoate indigenously.

**Objectives:**

- Study of different production/ synthetic routes of Emamectin benzoate
- Selection of suitable route
- Synthesis of Emamectin benzoate at laboratory scale
- Optimization of reaction conditions
- Physicochemical characterization
- Finalization of the most suitable route

**Present Status:**

- Laboratory scale synthesis of new MCPA derivatives is in progress.
- Laboratory work for the synthesis of Emamectin benzoate is in progress.

**Targets for 2019-20:**

- Lab work has been completed for the synthesis of MCPA-EH derivative and a representative sample has been successfully evaluated by M/s Kanzo AG Pvt. Ltd. Process to lease out the technology is under final stages.
- Laboratory work for the synthesis of Emamectin benzoate 90% is completed.
- Optimization of reaction conditions for the synthesis of MCPA derivatives are underway, and 90% work is completed.
- Physico-chemical characterization of MCPA-EH and MCPA derivatives has been carried out and the 75% work is completed.

## **Need Based R&D Projects (Phase-II)**

**Title:** Design and Development of Low Cost “Smart Flame Photometer”

**Project Leader:** Mr. Zain ul Abad, SSO

**Project Associate:** Dr. Abid Karim, SSO

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

### **Background:**

The flame analysis techniques are widely used for elemental detection and quantitative evaluation. Flame photometer is one of the simplest instruments to determine the concentration of some elements such as sodium, potassium and calcium. In this technique the sample is introduced to the flame, as vapours at controlled flow rate and flame intensity and emitted wavelength is monitored through the photoelectric circuitry. The intensity of the emitted wavelength depends upon the quantity of elements present in the solution. Selected filters are used for characteristic wavelength detection of elements and elimination of the contribution of other ions. Flame photometry is simple but low cost technique in comparison to flame emission spectroscopy, widely used in the industrial and Pathological Laboratories. In Pathological Laboratories, it is used to find the concentration of electrolytes to diagnose electrolyte imbalance in humans particularly children. In this project, the prototype model of the Smart Flame Photometer will be designed, developed, fabricated and tested for various real time experimental setups.

### **Objective:**

- To design, develop and fabricate a low cost Smart Flame Photometer, in order to fulfill the demand of local market and provide import substitute to save foreign exchange.

**Present Status:** On-going

### **Targets for 2019-20:**

- Interfacing and assembling of optics with burner modules.

- Testing and optimization of burner flame in combination with nebulizer.
- Testing and optimization of optical system in combination with filters and sensors modules.
- Calibration and validation of the working procedure and instrument.

### **Need Based R&D Projects (Phase-III)**

**Title:** Development of Spontaneous and Quantitative Method for Fluoride Estimation in Water

**Project Leader:** Dr. Asma Saeed, PSO

**Project Associate:** Ms. Shabana Kauser, SO

**Year of Initiation:** 2017

**Duration:** 03 Years

#### **Background:**

In Pakistan drinking water is generally consumed from surface water sources (such as rivers, canals or lakes) or the underground aquifers. At present around 70% of drinking water supplies come from underground aquifers. However, it is notable that at present groundwater is being contaminated by raw sewage waste, industrial effluents, or irrigation water containing large amounts of fertilizers and pesticides. The entrance of various contaminants ultimately destroys the natural chemical quality of drinking water. Among various water contaminants, fluoride is gaining much significance during recent times due to its negative impact on the living organisms. Excessive amount of fluoride consumption through drinking water beyond the recommended guidelines of World Health Organization (WHO) cause deterioration of human health thus developing a condition called “Fluorosis”. High levels of fluoride were found in the regions of Punjab, Sindh and Khayber Pakhtunkhaw. Many cases of fluorosis having deformed tooth discolouration, tooth decay, bone deformation and bone fractures are reported in Tharparkar, Pattoki, Manga Mandi, Nowshera, Raiwind, Kasur etc. Currently PCSIR is actively involved in the quality assurance of the chemical quality of drinking water for both ground and bottled water. It is therefore, important to develop a spontaneous and accurate method for the quantitative determination of fluoride in water.

#### **Objectives:**

- To develop quantitative, rapid and easy to run method for fluoride detection in water
- To develop analytical kit for the quantitative measurement of fluoride in water

**Present Status:** On-going

**Target for 2019-20:**

- Development of kit for testing is under process.

**Title:** Development of Nitrocellulose Lacquer

**Project Leader:** Dr. Abdul Qayyum Ather, PSO

**Project Associates:** Mr. Mohammad Usman Sabri, SO  
Mr. Ehsan-ul-Haq Najmi, SSO  
Ms. Mubeen Akhtar, SO

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

Nitrocellulose (also known as cellulose nitrate, flash paper, flash cotton, guncotton and flash string) is a highly flammable compound formed by nitrating cellulose through exposure to nitric acid or another powerful nitrating agent. When used as a propellant or low-order explosive, it was originally known as guncotton. A nitrocellulose slide and nitrocellulose membrane or nitrocellulose paper is a sticky membrane used for immobilizing nucleic acids in southern blots or northern blots. It is also used for immobilization of proteins in western blots and atomic force microscopy for its nonspecific affinity for amino acids. Nitrocellulose is widely used as support in diagnostic tests where antigen-antibody binding occurs e.g. pregnancy tests, U-Albumin tests and CRP. Glycine and chloride ions make protein transfer more efficient. Nitrocellulose lacquer is widely used in paint industry. Nitrocellulose lacquer is also used as coating material, glossing agent in printing ink and in leather finishes. It is an import substitute to fulfill the demand of local industries. Thousand tons of nitrocellulose is being imported by the local industries of Pakistan. Primarily nitrocellulose will be prepared by Lintered cotton afterward the nitrocellulose preparation will be attempted by using cellulose obtained from agrowaste like baggass, cotton sticks and pine leaves.

**Objective:**

- To fulfill the local demand of industries.

**Present Status:** On-going

**Targets for 2019-20:**

- The process for the synthesis of nitrocellulose is developed but its lacquer is not stable. The experiments to resolve the issue of solubility and stability of nitrocellulose lacquer is being carried out.

**Title:** Nano-Materials Based Coatings for Multifunctional Impacts on Glass Substrate

**Project Leader:** Ms. Phool Shahzadi, SO

**Project Associates:** Dr. Bakhat Bahadur Rana, SSO  
Mr. Akhtar Shahnaz, SO

**Year of Initiation:** 2017

**Duration:** 02Years (extended for 01 year)

**Background:**

Coatings deliver an invisible / visible and durable surface that provides different characteristics like water repellent, residue resistant, photochromic, thermochromic and antibacterial properties. Nano-coatings can be formulated for a long lasting, durable and environment friendly coatings for a wide variety of substrates. In present project, coatings will be developed for self cleaning, thermochromic, photochromic, antimicrobial and thermal insulation. The non-stick coatings enable smooth glass-like surfaces to have less contact with dirt particles. The hydro- effects cause particles of contamination to adhere less to the substrates and allow them to get easily removed from the water repellent coating, i.e. without applying any cleaning procedure.

**Objectives:**

To develop nano-coatings on glass substrate for various applications like;

- Strong hydrophobicity
- Excellent self clean performance on contamination.
- Antimicrobial
- Invisible to the human eye (coating thickness: 100-150 nm)
- Permanent (UV-stable, enormous abrasion-resistance)

- Thermochromatic
- Photochromatic
- Chemical-resistant

**Present Status:** On-going

**Targets for 2019-20:**

- Development of coating compositions and application on substrate.
- Characterization of coated samples.
- Report writing

**Title:** **Evaluation and Enhancement of Energy Efficiency of Electrical Motors**

**Project Leader:** Mr. Muhammad Azhar, SSO

**Project Associates:** Engr. Ali Imran, JE  
Mr. Abdul Majeed, TO  
Mr. Muhammad Saleem, SO

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

Electric motors use over half of all electricity consumed in most countries. Typically 60-80% of the electricity which is used in the industrial sector and about 20-35% of the electricity used in the commercial sector is consumed by motors. Motors system improvements produce substantial electricity saving and bring up opportunities to improve plant efficiency, to reduce the use of fuels, and to reduce greenhouse gasses. Additionally, the profitability and competitiveness of many economic activities can be significantly improved through the use of energy efficiency motor technologies. Energy standards and energy labeling are currently among the globally recognized strategies to promote the use of energy efficient household products. A very critical component of the Energy Efficiency Standards and Labeling (EES&L) Programme is the testing of product samples to verify the claims on energy ratings such as energy consumption and energy efficiency. Energy efficiency standards and labeling are about protecting consumer rights



to make an informed purchase decision. It is about helping consumers to cope up with the high cost of electricity by empowering them to choose the appliance make / model that provide the same amount of performance at lower energy consumption. Energy conservation has been getting an increased amount of attention in countries like Pakistan in the last five years. At the same time the climate change or climatic crises is rapidly getting worse and there is a need to reduce energy consumption through use of the energy efficient products. Induction motor is the key product which is being used at large scale. Hence, it is need to have the measuring setup for the energy efficiency of small induction motors. The project will also facilitate local industry to design, develop and manufacture high energy efficient, motors and other electrical appliances which will lead towards energy conservation.

**Objectives:**

- Review the power consumption spectrum of small rating induction motors based on local market survey / surveillance.
- Evaluate the energy efficiency of randomly selected samples of motors with respect to relevant minimum energy performance standards / specifications.
- Estimation of energy saving potential with due consideration of performance optimization including quality of critical components used for manufacturing of motors.

**Present Status:** On-going

**Targets for 2019-20:**

- Amendments in fabrication work in coupling of motors to connect with the Motor Testing System.
- The motor test bench needs repairing of motor fixing mechanism in order to avoid vibration.

**Title:** **Designing and Development of Blood Tube Sealer**

**Project Leader:** Mr. Aqeel Ahmed Khan, SSO

**Project Associates:** Mr. Sohail Akhtar, SSO      Mr. Zain Ul Abden, EO

**Year of Initiation:** 2018

**Duration:** 01 Year (extended for 01 year)

**Background:**

Blood transfusion is an essential therapeutic intervention. The collection of blood from donors may take place within the blood transfusion centre or hospital's blood bank. But in order to maintain its vital properties, care must be taken for factors of serious concern such as "bacterial contamination". For this purpose the blood tube was designed to seal the bags after blood collection automatically by applying high frequency operation *via* metallic electrodes. Electrodes have made from very high grade metal for perfect sealing. The bagged liquid sealing requires clean non-toxic, non-polluting, reliable bonding, convenient operation.

**Objective:**

- Development of Blood Tube Sealer.

**Present Status:** On-going

**Targets for 2019-20:**

- Development of sealing clamps
- Sealing mechanism development
- Fabrication of casing / body.
- Development of circuit.
- Procurement of electronic components / hardware.
- Testing and fixation
- Validation / End user certificate from Hospitals / Blood banks.

**Title:** Development of “Universal Centrifuge Control System”

**Project Leader:** Mr. Arif Karim, SSO

**Project Associates:** Mr. Faisal Ghazanfar, SO      Mr. Kashif Hussain, JTO  
Mr. Farhan Aziz, RA                      Mr. S. Junaid Hasan, TA

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

Centrifuges are common laboratory equipments widely used in a number of applications for accelerated sedimentation of suspended solids or immiscible liquids. These equipments are mainly imported and thus consume huge foreign exchange. In addition, the spare parts like balance sensor, RPM-sensor and electronic cards are usually not available in local market and need to be imported. At PCSIR Laboratories Complex, Karachi, there are number of centrifuges left abandoned due to the unavailability of spares or the huge amount of charges involved for the procurement / import of there spare parts. Generally, centrifuge has two major portions or sections, i.e. the “Mechanical Structure with Motor” and the “Electronic Control System”. Commonly wear and tear or damage occurs in the electronic control system and for its repair and maintenance components / parts are commonly imported. This project is aimed at the development of a “Universal Centrifuge Control System” that can be attached with any faulty centrifuge that are left abandoned due the involvement of electronic spars. Presently, we have three available faulty centrifuges that will be worked upon. The target specifications include:

- VFD (Variable Frequency Drive, i.e. 3-Phase Motor Controller) for RPM of 5000 to 20,000
- Imbalance sensing or vibration sensor
- Cooling / temperature controlling
- Evacuation control
- User interface for RPM, timer and rotor or RCF (Relative Centrifugal Force) value

**Objectives:**

- Development of “Universal Centrifuge Control System” to upgrade / retrofit the existing faulty centrifuges having only electronic problems.
- Revitalization of the abandoned faulty centrifuges through utilization of locally available VFD (Variable Frequency Drive, i.e. 3-phase motor controller), balance / vibration and

RPM sensors, evacuation system and microcontroller based user interface.

- Utilization of locally available spare parts and raw material in the development and fabrication of centrifuge control system.
- Elimination of reliance on imported spare parts i.e. import substitution and export promotion.

**Present Status:**

- Mechanical structure along with high speed motor has been arranged for integration of UCCS.
- Procurement of VFD (Variable Frequency Drive), RPM sensor and tachometer has been made.
- Integration of high speed centrifuge-motor with the VFD has been made and tested for around 14000RPM.
- Design of control panel has been completed. It comprises parameter and status display, control logic for cooling, door-control and process-timer.
- The RPM sensor was tested up to 3000RPM and it couldn't work at high speed. An alternate to the problem of (RPM-sensing) is in progress to get sensing in the full range of up to 15000RPM

**Targets for 2019-20:**

- Optimization of VFD program will be performed for deceleration of centrifuge motor at desired rate.
- Procurement of programmable logic controller, Plastic/aluminum/fiber sheet will be carried out in the next quarter to fabricate prototype penal-box.
- Final testing and verification of UCCS and its software will be performed.

**Title:** Development of Process for Commercial Production of Lactulose

**Project Leader:** Dr. Yousaf Ali, SSO

**Project Associate:** Ms. Humaira Inayat, SO

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

Lactulose is a synthetic disaccharide normally used in the form of syrup for the treatment of intestinal disorders, as a sweetener constituent of sucrose, as a food supplement in pediatric diets and as a geriatric food. The addition of lactulose in the diet of elderly can effectively create soft bowel movements and regularity. It has potential therapeutic application in the treatment of constipation and other intestinal disorders. In spite of the recognized large potential of lactulose and a reasonable amount consumed every year, there is no such unit which manufacture the nutraceutical product locally.

**Objectives:**

- To provide an economically feasible improved process for manufacturing of lactulose.
- Development of food supplements and pharmaceutical formulations for commercialization purpose.

**Present Status:** On-going

**Targets for 2019-20:**

- Application of selected routes to synthesize pure product on lab scale
- Isolation and purification of final product and development of formulation(s) for commercial purpose
- Bulk preparation of lactulose on pilot plant scale

**Title:** **Designing, Fabrication of Energy Efficient (Dual System) Water Heater**

**Project Leader:** Engr. Saiful Islam, PE

**Project Associates:** Engr. Sohail Ameer Marwat, PE  
Engr. Muhammad Younas, SE

**Year of Initiation:** 2017

**Duration:** 02 Years (extended for 01 year)

**Background:**

To save natural resources of gas reserves a super designing will be done to enhance the efficiency of water heater (Geyser) from 19% to considerable level and also to convert the day time utilization of natural gas to solar energy system as the geyser will work on dual system. On account of efficiency enhancement the base material directly in contact with flam is converted to highly heat conducting material i.e. copper, while a pre heater will be installed in the way of flue gases going out of the burned gases. Further modification will be made by using rustles material having low thermal conductivity. This will boost up the life of geyser as well as minimize the heat losses to the atmosphere. Two solar panels will be used for D.C. power generation and will directly used for heating purposes through heater arrangements. Due to this arrangement, day time heating can be achieved.

**Objectives:**

- To develop an efficient water geyser working on dual system i.e. working in day time on solar energy and in night on natural gas in order to save considerable amount of fuel i.e. natural gas.
- To produce the fuel economy geyser in the market.

**Present Status:** On-going

**Target for 2019-20:**

- Comparative study on energy and economy basis

<b>Title:</b>	<b>Production of Antimony Trioxide from Antimony Ore</b>	
<b>Project Leader:</b>	Mr. Zaheer ud din, SSO	
<b>Project Associates:</b>	Ms. Huma Ayub, SO	Mr. Khurram Shehzad Buzdar, SO
<b>Year of Initiation:</b>	2017	
<b>Duration:</b>	02 Years (extended for 01 year)	

**Background:**

Antimony alloys are used in storage battery plates, anti-friction bearings, bullets and lead shot cable. Antimony oxide is used as a dopant in N type metal, tracers and decorative casting and is also involved in many other productive engineering tools. Balochistan has large quantity of antimony. The industrial methods for refining antimony ore are roasting and reduction with carbon or direct reduction of stibnite with iron. The largest application for metallic antimony is an alloy with lead, tin and the lead antimony plates in lead–acid batteries. Alloys of lead and tin with antimony have improved properties for solders, bullets and plain bearings. Antimony compounds are prominent additives for chlorine and bromine-containing fire retardants found in many commercial and domestic products. An emerging application is the use of antimony in microelectronic. The purpose of this project is to utilize Balochistan ore as an indigenous source for the production of antimony trioxide which can be further used in different industries.

**Objectives:**

- To explore the mineral of Balochistan for value added products.
- To develop cost effective processes for synthesis of antimony trioxide on industrial scale.
- To provide antimony trioxide to end users on cheaper rate.
- To minimize import of chemicals and save foreign exchange.

**Present Status:** On-going

**Targets for 2019-20:**

- Trails of antimony trioxide at bench scale
- Production of antimony trioxide

## **PCSIR Laboratories Complex, Karachi**

**Title:** Synthesis Characterization and Biological Evaluation of Transition Metal Complexes

**Project Leader:** Ms. Sofia Khalique Alvi, PSO

**Project Associates:** Mr. Muhammad Kamil, SSO  
Mr. Sheraz Shafiq, SO Mr. Ghulam Fareed, JTO

**Year of Initiation:** 2018

**Duration:** 02 Years

### **Background:**

Inorganic compounds particularly transition metals have played an important role in the development of new metal based drugs and in some cosmetic formulations. The application of these metal complexes in the areas of pharmacy, microbiology and cosmetology has been expatiated to provide an insight of the contribution of inorganic chemistry towards drugs and cosmetic delivery. The fundamental role of copper and its complexes as important bioactive compounds *in vitro* and *in vivo* aroused an ever-increasing interest in these agents as potential drugs for therapeutic intervention in various diseases. The vast array of information available for their bioinorganic properties and mode of action in several biological systems, combined with the new opportunities offered by the flourishing technologies of medicinal chemistry, is creating an exciting scenario for the development of a novel generation of highly active drugs with minimized side effects which could add significantly to the current clinical research and practice. Complexes containing cobalt have been used in medicine. More recently, cobalt(III) based ligand complexes have been found to possess both antiviral and antibacterial activities. Only a small number of cobalt(III) complexes are known to have biochemical roles. Vitamin B12 is a cobaloxime, a cobalt complex containing a glyoxime ligand, and is one of the rare examples of a naturally occurring organometallic complex i.e. possessing a metal carbon bond. Nitrile hydratase possesses cobalt in oxidation state 3+. Co(III) is also found in certain cobalt-porphyrin containing proteins. The simple  $\text{Co}^{3+}$  ion is unstable in water, but can be stabilized against reduction to  $\text{Co}^{2+}$  by coordination to ligands or chelators. By far the most common ligand type used to stabilize the cobalt(III) ion in aqueous solution is the chelating N,O donor ligand. Surprisingly, cobalt(III) complexes derived from this ligand donor set have found application as



antibacterial or antiviral agents.

**Objective:**

- Synthesis of transition metal complexes of cobalt, copper, chromium and their biological studies.

**Present Status:**

- 3 complexes have been synthesized and their characterization and investigations for biological activity are in progress.

**Targets for 2019-20:**

- Characterization and investigations for biological activity of 3 transition metal complexes of cobalt, copper, chromium.
- To file the patents.

**Title:** **Reclamation of Saline and Sodic Soils of Coastal and Inland Waste Lands.**

**Project Leader:** Dr. Sofia Khalique Alvi, PSO

**Project Associates:** Dr. Tahir Rafique, SSO      Mr. Sheraz Shafiq, SO  
Dr. Beena Naqvi, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Pakistan is an agriculture country and major part of our economy is based on it. At present, the arable land is deteriorating due to poor management systems resulting in water logging, salinity, infertility etc. Salinity and sodicity create stressful conditions for plant growth and converting arable land into wasteland. Both Salinity and sodicity affect plant growth by reducing crop yields and beyond certain level of salinity, the plant won't survive. Saline soil is described as excessive levels of salts whereas sodic soils have excessive levels of sodium adsorbed at the cation exchange sites. Soil sodicity causes degradation of soil structure. The primary effect of

salinity and sodicity on plants is to limit the ability of plant roots to absorb soil water even under wet soil conditions. The soil solution with low osmotic potential due to higher concentration of soluble salts compared to the plant cells, will not allow plant roots to extract water from soil, causing drought-like symptoms in the plants. The most common soluble salts in soil are the sodium, calcium and magnesium. In soil suspected as being saline or affected by sodium, the extent of the problem which management is difficult to determine unless the soil is analyzed for various parameters by using laboratory procedures. There are various methods to reclaim the wasteland into arable land based on scientific research using biological and chemical methods. For reclaiming soils biologically which forms numerous life forms, that can reduce the salinity when introduced such soil. Whereas, chemically a number of treatments like gypsum treatment, acid treatment, water management etc are used worldwide. The analytical section of Applied Chemistry Research Centre (ACRC) is involved in soil testing for last many years. A number of samples from all over Sindh province have been evaluated for their salinity and fertility but in some cases the suggestions have also been provided to improve soil quality and crop yield. Present study intends to do experimental trials for soil reclamation by using chemical methods on saline sodic fields in the vicinity of PCSIR Labs. Complex, Karachi. The scope of the study would be increased to various other wastelands in the province of Sindh.

**Objectives:**

- To investigate extent of salinity / sodicity.
- To reclaim saline sodic soils of various coastal and inland areas.
- To convert wasteland into arable land.
- To develop a feasible scientific approach for soil reclamation.
- To establish protocols for reclamation with respect to the salinity and sodicity of soils.

**Present Status:**

- A demonstration field for agri-business will be established within the premises of PCSIR Labs. Complex, Karachi. This field is waste lands that lie barren with fragmitis invasion. Initial soil investigation shows that the quality of soil is poor, the soil is compact alkaline saline and sodic. This field is to be reclaimed through gypsum and sulfuric acid treatment. The work is in progress and drip irrigation system is also to be installed for proper water management.

**Targets for 2019-20:**

- Feasible approach for reclamation of wastelands to arable lands.
- Development of protocols for reclamation of saline and sodic soils.

- To share knowledge with the scientific community in form of publication and process development.

**Title:** Development of Industrial Inkjet Ink for Textile Printing

**Project Leader:** Mr. Aijaz Ali Panhwar, SE

**Project Associates:** Mr. Mansoor Iqbal, SO      Mr. Karman Ahmed, EO

**Year of Initiation:** 2018

**Duration:** 03 Years

**Background:**

Market research has indicated much interest in inkjet inks for textile printing. Inkjet inks are used for digital printing in textile industries and are imported in large quantity inflicting heavy foreign exchange. The requirements for printing inks are diverse and depend on field application. The ink used for digital printing must offer high quality because of environment in which they are used. They must have very low viscosity, so that they can flow through very small nozzles and stable at high temperature 300°C. The digital printing industry is showing significant transformation with new technologies. Digital inkjet sublimation printing has become one of the most important textile production printing technologies and is in fact transforming the entire industry. Due to inkjet inks textile manufacturers and textile printers are now able to produce a variety of colour prints and designs in very short time with less effort. Inkjet inks have converted tedious work of printing and designing into interesting master pieces.

**Objective:**

- To develop high quality, cost effective, reliable and value added inks for inkjet printing for textile sector.

**Present Status:**

- More than 05 trials are completed.
- The yellow colour has been developed.
- Further, the physical and chemical properties of industrial inkjet for textile printing, other trials are in progress to achieve red, blue and black colour ink.

**Targets for 2019-20:**

- To develop cost effective and more intense colour.
- To enhance the properties.

**Title:** Establishment of the Instrumental Setup for the Optical (Light) Sensing, Testing and Simulation.

**Project Leader:** Dr. Abid Karim, SSO

**Project Associates:** Mr. Sheikh Kamaluddin, SO  
Mr. Aqeel Ahmad Khan, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Optical sensors, components and instruments are used widely in highly sophisticated laboratories as well as in our domestic home appliances, such as spectrophotometers, lightening devices, DVD drives, lasers etc. Most of these instruments are based on the detection and simulation of the optical response of the sensor. The optical response has a key role in the accuracy and reproducibility of results for the instrumental application and devices. Therefore, the characterization of the optical sensors have key role in the testing and quality assurance which can be used for the design and development along with better maintenance skills.

**Objective:**

- Various sensors available in local market will be tested, analyzed, interpreted and simulated in order to upgrade / modify / quality assurance of the optical instruments

**Present Status:** New Project

**Target for 2019-20:**

- Establishment of the experimental arrangements for the testing of the various optical (light) sensors and emitters.

**Title:** Development of UV-Visible Spectrophotometer

**Project Leader:** Mr. Arif Karim, PSO

**Project Associates:**

**For Electronics & Software Development**

Mr. Faisal Ghazanfar, SO      Mr. Kashif Hussain, JTO  
Mr. Farhan Aziz, RA          Ms. Seema Firdous, SSO  
Mr. Mansoor Hai, JTO  
Mr. Mujahid Hussain, Computer Operator  
Mr. Waseem Ahmad Shaikh, Tech. Assistant

**For Optics Design, Mechatronics Work**

Dr. Abid Karim, SSO          Mr. Aftab Ahmad Usmani, SSO  
Mr. S. Kamaluddin, SO      Mr. Akhtar Ali Khan, TO  
Mr. Anees Ahmad, TO

**For Application, Calibration & Validation**

Mr. Zainul-e-bad, SSO      Mr. M. Shamshad, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Spectrophotometer is a basic scientific instrument which is use widely for qualitative and quantitative analysis of compounds. The basic building blocks are the light-emission source, the monochromator, the sample cell or cuvette, photo-detector, digital readout and the microprocessor based control system. The fabrication complexity is not so tough and that's why can be developed in PCSIR. An example of such development is the India, where they develop Spectrophotometers and Gas Chromatograph to meet the local requirements. This project is aimed to develop low cost Spectrophotometers to substitute import. The development involves electronic-control-system, computer-software and over-all mechanical structure of a radiation source, monochromator, grating, sample cell, detector, and digital-display with keypad. Two models are planned to develop, i.e, Visible-range and the UV-Visible range. Presently, there is

great need of spectrophotometers in PCSIR, such development will help us to get low cost alternatives to import. The target specifications include:

- Visible and UV-Visible range (200nm to 900nm).
- Absorbance and transmittance readout/display.
- Wavelength display with keypad for user interaction.
- Control and acquisition software for instrument with display and keypad.
- Computer software for control, data acquisition and analysis.

**Objectives:**

- Development of low cost spectrophotometer utilizing the locally available parts/sensor, raw material and human resource.
- Elimination of reliance on costly imported systems and its spare parts i.e. import substitution and export promotion.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Literature survey and market survey for the availability of electronic and optical components.
- Procurement of electronic and optical components and their testing.
- Designing the optical setup for the spectral analysis and control. Fabrication of prototype assembly of optical system.
- Designing and fabrication of electronic control system. Developing primary software for the control and display of test results.
- Primary calibration of wavelength. Testing of analysis results for various standards i.e. wavelength and concentrations.
- Testing of various light sensors and its performance for the working span of wavelength.
- Testing of various light sources and its performance for the working span of wavelength.
- Finalization of the light sources and sensors and its integration in the prototype assembly.
- Finalization of the electronic control circuits and its embedded software.
- Designing and developing PC-software for the instrument.
- Final testing, calibration and tuning of control circuit and software.

**Title:** Development of “IR Dyeing Bath Programmable Controller”  
by Using PLC/Microcontroller Technologies

**Project Leader:** Mr. Arif Karim, PSO

**Project Associates:** Mr. Faisal Ghazanfar, SO      Mr. S. Junaid Hussan, TA  
Mr. Kashif Hussain, JTO      Mr. Farhan Aziz, RA

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

The IR dyeing machine is a state of the art dyeing instrument most commonly used in textile industries for quality control of dye/pigments. The unit comprises of heaters, sample holders and forced air cooling system. The whole equipment is controlled by a cyclic-process where steps to rise and fall of temperature carried out in a sequence of time-program. The user program of the equipment in different number of steps depends on the dye and cloth. Presently, the electromechanical structure is already developed. However, the requirements with electrical controller couldn't be achieved. For this, an intelligent software based controller is to be incorporated in the unit. Experiments are initiated for its development and fabrication of programmable controller.

**Objectives:**

- Development of IR dyeing bath controller for IR dyeing bath laboratory equipment.
- Utilization of PLC (Programmable Logic Controller)/Microcontroller (Atmel) and LCD (Liquid crystal display) in IR dyeing bath, as it is easily available in the local market and can easily be maintained, serviced and upgraded.
- Capability development for the utilization of PLC/Microcontroller, so as to meet the new challenges of cutting edge technologies in local textile industry.

**Present Status:** On-going

**Targets for 2019-20:**

- Testing and verification of available transducers/motors and wiring of existing dyeing bath.
- Lab scale process analysis and electronics development, comprising of various control

parameters like cooling, heating, speed of motor.

- Integration of PLC or microcontroller in the IR dyeing bath.
- Software development for over all control and user-interface.
- Preparation of operating manual and finalization for commercial use.

**Title:** **Design and Development of Growth Chamber (Digital) (Temp Range: 0 to 50 °C) with Humidity Control and Day/Night Timer**

**Project Leader:** Mr. Sohail Akhtar, SSO

**Project Associates:** Mr. Aqeel Ahmed Khan, SSO  
Mr. Muhammad Mazhar ul Islam, EO  
Mr. Zain-ul-Abdin, EO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

The plant growth chamber is designed to produce environmental conditions (humidity and temperature) that maximize plant growth. Growth chamber had been procured by educational institute, R&D organization, production industries etc. from diverse source with variety of manufacturer. The development of Growth chamber has initiated to fulfill the need of costly imported equipment. Growth chamber is used in agriculture and botanical research applications like plant pathology, seed germination and in plant research (photosynthesis /nutrition) and also in plant tissue culture studies. In Growth chambers or cabinets the humidity, temperature and lights are controlled as per desire environments and essential growth of a particular plant examined. The equipment properly works into a perfect cooling systems, humidity controller and timer and works at 24/7 days. Growth chamber can be used up to a maximum temperature of 50° C with humidity up-to 95%. The lower operating range 0°C is attainable with an accuracy of + 1.0 °C. The equipment also comprises day and night timer for lights in the growth process. Growth chamber constitute a valuable tool that produces real time environmental conditions favourable for plants growth. The present study is aimed to develop commercial products from local market and fabricates laboratory equipment on engineering lab scale with price reduction and import substitution.



**Objectives:**

- To develop a commercial model Growth chamber (70- 100 Litres) (digital), that can produce daily and hourly changes in light and temperature with reasonable precision.
- To design and fabricate Growth chamber as per market need .
- To develop indigenous technology.
- Commercialization of Growth chamber to increase revenue.
- Saving of foreign exchange.

**Present Status:** New project

**Targets for 2019-20:**

- Body construction/fabrication (Internal chamber stainless steel, Exterior: MS Body powder coated, and colouring and Screen Printing etc.
- Procurement of control systems components.
- Fixation of cooling and heating system, with humidifier.
- Electrical / electronic and mechanical parts fixation.
- Testing and quality control.

**Title:** Design and Fabrication of Analytical Equipment (Pin Hole Tester for Paper Board)

**Project Leader:** Mr. Shahid Bhutto, SSO

**Project Associates:** Engg. Razia Begum, PE Dr. Nusrat Jalbani, SSO  
Dr. Uzma Rashid, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Present study is based to improve laboratory facility with new equipment namely Pin Hole Tester. The paper board imported to Pakistan need to be checked by FBR for compliance of national/international standards. One of the requirement is to check Pin Holes in the board. The Pin Hole indicates improper processing and/or material defect. The PCSIR-KLC has already completed two referred projects in 2017 for FBR including Pin hole testing. These tests are

mandatory requirement by FBR Pakistan. Further these standards were strengthening by their next level of examination and detection with precise results.

**Objectives:**

- To design and fabricate an Analytical Equipment for determination of Pin Hole in paper board.
- To provide updated and enhanced services to importers and regulatory authorities.
- To develop an analytical equipment (Pin Hole Tester) as import substitute.

**Present Status:** New Project

**Targets for 2019-20:**

- To design the equipment as per standard
- To fabricate the equipment and validate the result

**Title:** Development of Analytical Equipment “Paper Light Feature Tester”

**Project Leader:** Mr. Shahid Bhutto, SSO

**Project Associates:** Engr. Razia Begum, PE      Mr. Arif Karim, PSO  
Mr. Abid Karim, SSO      Mr. Sheikh Kamal, SSO  
Mr. Zainul Ebad, SSO      Dr. Nusrat Jalbani, SSO  
Dr. Uzma Rashid, SSO      Mr. Mazar-ul-Imam, E.O  
Mr. Akhtar Ali Khan, TO

**Year of Initiation:** 2019

**Duration of Project:** 01 Year

**Background:**

A security paper (CBS-1) is widely used to control fraudulent in banking system, however the security feature were previously based on chemical sensitivity test only. Further orders have been passed by State Bank of Pakistan to revive the existing standards of CBS-1. In the new standard UV-feature and Watermark were declared compulsory. In order to produce reliable results PCSIR need to either purchase the new machine or fabricate one from its own resources.

The purpose behind development of such equipment is enhanced feature for research and better understanding of security features.

**Objectives:**

- To develop new analytical equipment with enhanced features as compare to available devices in the market.
- To initiate research in the area of security features of paper.
- To provide testing facility of UV-feature and Watermark analysis to clients (Banks).
- To fabricate a tester with new features / parameters.

**Present Status:** On-going

**Targets for 2019-20:**

- To complete trails of the analytical equipment.
- To validate the results and provide testing facility of new parameters to clients (Banks) as well as to initiate research in security paper.

**Title:** Preliminary Determination of Air Quality Index (AQI) for Atmospheric Trace Gases and Particulate Matter from Flower Beds, Parks and Green Areas of Karachi City.

**Project Leader:** Dr. Durdana Rais Hashmi, PSO

**Project Associate:** Dr. Akhtar Shareef, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Air quality is the main factor in the atmospheric environment which effects the state of health and disease in both man and animals. The modernization and industrialization of developing countries has led to the increased use of fossil fuels and their derivatives. Atmospheric pollution is deteriorating continually due to emission from flue gases, vehicular and industrial emission. Status of ambient air quality can easily be understood or calculated by Air

quality index (AQI). In a simple way AQI shows that ambient air is how much polluted and what are the health hazards for the citizens.

**Objectives:**

- To express the status of ambient air quality of Karachi city in the form of Air Quality Index (AQI).
- To aware the public about the risk of pollution level day to day and to prepare for precautionary measurement and to regulate the safety measures for health hazards.

**Present Status:**

- Data collection and survey is in progress.

**Targets for 2019-20:**

- Survey and collection of data for atmospheric pollutants from different flower beds, Parks and green areas of Karachi
- Data will be used to aware and mitigation of health hazards.
- Publication of research paper to aware the public regarding the mitigation of health hazards.

**Title:** Study and Environmental Assessment of Rain Water Coastal Areas of Sindh

**Project Leader:** Dr. Nusrat Jalbani, SSO

**Project Associates:** Mr. Farooq Ahmad Khan, SEO  
Mr. Shahid Bhutto, SSO Dr. Uzma Rashid, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Floods have always been a serious problem for coastal areas of Sindh in rainy season. At the peak of monsoon season, especially in June to July, most of the capital regions are flooded with fluctuating water level. Even after floods recede still leaves health problem including

itching disease, fever, hypertension, rheumatism, skin diseases and under respiratory infection. Flooding does not only cause economic losses, damage to public facilities and environment but also degrades the image of coastal areas of Sindh. This surely can reduce the impact of environmental, social, and economic conditions that may occur during and after flood. Very few studies have been conducted and limited data is available about the rain water management in coastal areas of Sindh.

**Objectives:**

- A comparative study on water quality will be carried out in pre-monsoon and post-monsoon seasons of coastal areas of Sindh.
- Analysis of rain water samples for physical, chemical and microbiological parameters
- To develop the proposed methodology.

**Present Status:**

- Rain samples from different areas of Karachi were collected.
- Physico chemical analysis is in progress.

**Targets for 2019-20:**

- Metal analysis /acid analysis.
- Collection of samples from different region of Sindh.
- After comprehensive finding study will be concluded to propose safe storage of rain water.
- Publication of data.

**Title:** Recycling of Sulphuric Acid in the Pakistan Aluminum Industry Use Membrane Technology

**Project Leader:** Engr. Razia Begum, PE

**Project Associates:** Dr. Tooba Naveed, SSO Mr. Niaz Ahmad, SO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

Aluminum anodizing and hard coating is an electrochemical process in which an oxide (anodic) layer is chemically built on the surface of the metal. This oxide layer/film acts as an insulator. Anodizing provides surface corrosion protection along with an excellent substrate, abrasion resistant and non-conductive aluminum oxide ( $Al_2O_3 \cdot xH_2O$ ) for decorative finishes. Implementing bath purification alleviates this buildup and promotes the generation of a consistent, predictable oxide coating. To compensate for this increased resistance, the rectifier voltage must be increased in order for the current to remain constant. One of the major concerns related to environmental pollution on national level can be controlled a large quantity of free sulfuric acid remains when the anodizing solution is discarded once the aluminum concentration reaches unacceptable levels. So, best option is recycling of huge amount sulphuric acid through membrane technology and re-use in aluminum industry and save concrete sewer lines.

**Objectives:**

- To develop a process for the recycling of sulfuric acid for aluminum industry.
- To design and fabricate a mini capacity purification unit for the recycling of sulfuric acid.

**Present Status:**

- Process for the recovery of  $H_2SO_4$  has been developed.
- Lab scale model plant is in progress.

**Target for 2019-20:**

- A process and plant will be developed.

**Title:** Evaluation of POPs from the Supply Chain and Dumping Sites of Plastic Scrap and E-Wastes in Karachi.

**Project Leader:** Dr. Sohail Shaukat, SSO

**Project Associates:** Engr. Razia Begum, PE      Dr. Hina Ahsan, SSO  
Ms. Aisha Farhan, JEO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

Polybrominated diphenyl ethers or PBDEs are organobromine compounds that are used as flame retardant. They are structurally akin to the PCBs and other polyhalogenated compounds. Like other brominated flame retardants, PBDEs have been used in a wide array of products, including building materials, electronics, furnishing, motor vehicles, airplanes, plastics, polyurethane foams and textiles. The health hazards of these chemicals have attracted increasing scrutiny and they have been shown to reduce fertility in humans. Because of their toxicity and persistence, the industrial production of some PBDEs is restricted under the Stockholm convention, a treaty to control and phase out major persistent organic pollutants (POPs). At an international level, in May, 2009 the parties of the Stockholm convention for Persistent Organic Pollutants (POPs) decided to list commercial penta BDE and commercial octa BDE as POP substances. However, hexa BDE is not yet enlisted in the POPs but under the watch list chemicals to be included in POPs in the near future. As a signatory of Stockholm convention, Pakistan is bound to prepare an inventory of POPs and action plans for their removal. Therefore, present proposed project will be a contributory effort in our national task of POPs elimination.

**Objective:**

- To gather a base line data regarding the distribution of polychlorinated biphenyls and polybrominated diphenyl ethers from the various plastic and e-waste supply chains and dumping sites of Karachi.

**Present Status:**

- Method has been developed.

- Base line data is generated.
- Visit of M/S Enviro enterprises regarding the environmental management plan for the import scrap.

**Targets for 2019-20:**

- Data compilation of plastic waste analysis.
- Sampling of e-waste.
- Verification of method of poly brominated biphenyls for the analysis of e-waste.

**Title:** Isolation, Purification, Characterization of Eugenol and Synthesis of Methyl Eugenol from Eugenol.

**Project Leader:** Engr. Razia Begum, PE

**Project Associates:** Dr. Sohail Shaukat, SSO      Dr. Hina Ahsan, SSO  
Ms. Aisha Farhan, JEO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Methyl Eugenol (ME) is used in insect traps to attract certain fruits flies such as the oriental fruit fly on affected food crops. In Pakistan, ME is used extensively especially in mango farming and being imported from abroad. It is not produced in Pakistan, therefore, the growers purchase it from importers. This creates a burden over them in terms of finances and in time supply. Thereby, the grower community is seeking for the local production.

**Objectives:**

- To isolate the Eugenol from different plants and compare the yields in terms of the financial feasibility for pilot scale production.
- Characterization of Eugenol focusing its usage in pest attraction.
- To synthesize Methyl Eugenol from Eugenol.
- Optimization of isolation and synthesis processes.

**Present Status:** On-going

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**Targets for 2019-20:**

- Metuflame of Eugenol.
- Pilot scale production.

**Title:** Quality Assessment of Food Grade Paper

**Project Leader:** Mr. Shahid Bhutto, SSO

**Project Associates:** Dr. Akhtar Shareef, SSO Mr. Farooq Ahmed Khan, SO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

Evaluation of quality of pulp/paper in Pakistan is very important for the sake of prohibition of environmental pollution with respect to environment, safety and health of inhabitants. Similar finding of the major problems in pulp/papers industries are necessary. The present study is focused to know the exact nature of fiber and their analysis of food grade paper. This will greatly help in the manufacturing of finished paper and packaging materials for the food. There are three types of paper fiber making from wood, non wood and wild plants. In Pakistan, the paper mills manufacture the papers from this raw material (wheat straw, rice straw, rice husk and bagaas) which have no better quality and Government duty and tax is above 25%.

**Objectives:**

- To disseminate information/awareness to use food grade paper.
- To provide technical assistance for manufacturing of food grade paper.
- To develop national standard of food grade paper.

**Present Status:**

- The paper quality assessment is under progress.
- Further consultation with industries is in progress.

**Targets for 2019-20:**

- To collaborate with paper industries for support in food grade standard preparation for

national food grade paper and paper board standard will be suggested to federal government.

- Establishment of full-fledged food grade packaging testing/certification facility at PCSIR-KLC.

**Title:** **Recovery of Silver from Used X-Rays Film and Other Radio-Graphs**

**Project Leader:** Engr. Muhammad Ali Imran, JE

**Project Associates:** Mr. B. K. Ahuja, PE                      Mr. Muhammad Ilyas, EO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

With the development of science and technology and increasing population, the health facilities are developing very fast. Due to this reason, the consumption of X-ray, MRI and CT scan films are increasing rapidly. Silver is the major cast component which is present as thin coating on these films. Waste prints, negatives and used films are disposed off often in municipal waste streams, ending up in landfills or incinerators, which leads to environmental pollution and incineration of used films leads to loss of silver. The recovery of silver from radiographic wastes has number of impacts:

- **Technologically;** by using radiographic waste on current production flows, thus replacing poor raw material.
- **Economically;** the process can substantially reduce manufacturing costs by recycling waste.
- **Socially;** by creating new jobs to process the waste in a form more suited to technological flows.
- **Ecologically;** by removing waste that is currently produced or already stored but possess a threat to the environment.

**Objectives:**

- To reduce the municipal waste.
- To develop the cost effective process for the recovery using cheap resources.

- To maximize the purity of recovered silver.
- The proper disposal of the polymeric support.
- To develop a more efficient recycling technology for medical radiographs.

**Present Status:** On-going

**Targets for 2019-20:**

- To optimize the percent yield of recovered silver.
- To make the process cost effective.
- To develop a method / process to recycle the plastic waste.

**Title:** Design and Fabrication of Hybrid Generator for Highway Street Lights

**Project Leader:** Engr. Adeel Ahmed Khan, JE

**Project Associate:** Engr. Mazhar Ali, JE

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

The sources for renewable energy are not developed on a large scale in developing countries. Reserves of fossil fuel such as coal, oil and natural gas are in a huge amount and cheap. Today, as the world watches developing nations turn into industrial power-houses; many people are advising that these newly developed nations start with renewable energy resources in order to save money as well as prevent more greenhouse gasses from entering world's atmosphere. Therefore, renewable sources such as wind, tidal, geothermal energy etc. become valuable resources around the world. Pakistan is the country that is blessed with large coastal area as well as 30% its total area is at high altitude with great potential of wind energy as the wind speed generally exceeds 6m/s. The present project aims at the performance and design improvement of vertical axis wind turbine rotor with various reducer angles and reduced the opposite wind pressure on conventional vertical turbines, of the order of less than 12 m/sec, which are normally present. The wind turbine should be a self-starting device to meet the requirements and wind velocity fluctuations. Also the structure bears a solar panel fixed on top

and the working effects of the turbine should not affect the efficiency of the output power of the solar panel.

**Objectives:**

- To design such vertical axis turbine that reduces the installation area.
- To reduce the billing cost on NHA City Govt. for the street lights installed on highway and streets.
- To generate alternate power using green fuel.
- The other important factor is the downsizing and a sleek outlook of the product which is intended to perform these functions.

**Present Status:** New Project

**Targets for 2019-20:**

- Literature survey.
- Selection of materials for development / fabrication of vertical axis wind turbine.

**Title:** Application of Ozone Fumigation Technology to Control Aflatoxin Contamination in Food Commodities

**Project Leader:** Mr. Muhammad Asif Asghar, SO

**Project Associates:** Dr. Farman Ahmed, SSO Dr. Samee Haider, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Mycotoxins are secondary fungal metabolites and produced by various toxigenic species such as *Aspergillus*, *Fusarium*, *Penicillium*, etc. A group of mycotoxins enthralling consideration for being potentially dangerous are the aflatoxins (AFs), ochratoxins, citrinin, zearalenone and trichothecenes. AFs are the most common mycotoxins and mainly produced by the *Aspergillus flavus*, *A. nomicus* and *A. parasiticus*. AFs are reported as hepatogenic, carcinogenic, mutagenic, immune suppressing and neoplastic. To date, 18 different types of AFs have been identified. However, only four aflatoxins (AFB<sub>1</sub>, AFB<sub>2</sub>, AFG<sub>1</sub> and AFG<sub>2</sub>) are of considerable importance

regarding their recurrence amongst cultures and food products. AFs can create potential risk to human health with aflatoxicosis and cancer. The production of AFs is highly depending on various factors such as, moisture, temperature, water activity, pH and oxygen concentration. The pre-harvested and stored products are prone to fungal attack. The insect wounds on the pistil of the flowers might serve as the germinating beds for fungal spores, thus, resulting in AFs production. Post-harvest contaminations of AFs take place particularly during floods, unseasonal rains or improper storage of insufficiently dried agricultural products. The temperate, sub-tropical and tropical climates invite aflatoxin-producing moulds. In the light of above mentioned facts, the use of effective and efficient physical and chemical methods is required for the reduction of AFs in food commodities. In addition to the technical and the economical considerations, such processes should reduce toxin concentrations to safe levels and in its own turn save the nutritive values of the crops.

**Objectives:**

- To focus on the AFs detoxification using ozone treatment in food commodities.
- To assure that nutrients in the food are not destroyed by the ozonation processes.
- To evaluate the formation and distribution of ozone-Aflatoxin and ozone-corn reaction products.
- To help in increasing revenue for exporter and importer thus provide safer products to the consumers in or abroad the country.
- To provide guidelines to the local farmers, food industry, exporter, etc.
- Detoxified commodities can be exported to many countries as value added products.

**Present Status:**

- Testing facilities for the AFs contamination are already well-established.
- Regular testing for monitoring of AFs and other mycotoxins in varieties of food commodities intended for export.

**Targets for 2019-20:**

- To develop the detoxification technology of AFs using ozone in selected food commodities and confirm by HPLC and TLC techniques.
- The source of ozone for the detoxification of AFs will be recognized.
- The effects of the ozonation fumigation on nutrients, specifically lipids and proteins, in the food commodities will also be studied.

**Title:** **Detoxification of Mycotoxins Contamination in Poultry Feed through Nano Adsorbent.**

**Project Leader:** Dr. Farman Ahmed, SSO

**Project Associates:** Mr. Muhammad Asif Asghar, SO Mr. Muhammad Inam, RA

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

In Pakistan, poultry production is one of the most dynamic and well organized segments contributing 26.8%, 5.76% and 1.26% to total meat production, agricultural sector and overall GDP, respectively. Recently, the poultry sector has proven excellent growth and has emerged as a source of employment for more than 1.5 million people. Presently turnover of Pakistan Poultry Industry is about 750 Billion rupees. Poultry feed and their ingredients could be contaminated by toxigenic moulds during harvesting, improper drying, handling, packaging, storage and transportation. One of them is contamination of poultry feed by mycotoxins which is increasing day by day. Among these, aflatoxins (AFs) are most documented of all mycotoxins. AFs are reported as hepatotoxic, mutagenic, immunosuppressive and neoplastic. There are many factors that influence the production of Aflatoxin including feed type, storage condition, moisture content and region where feed present. Poultry are extremely sensitive to AFB1 to dose as low as 15-30 µg/kg. The pathological effect of aflatoxins on poultry is mainly related to growth rate. The absolute body weight and weight of liver, bursa and spleen also decrease. Additionally, anorexia, listlessness, decrease in egg production and increase in mortality are also observed. Anemia, decrease in immune response, hepatotoxic, mutagenic, carcinogenic and teratogenic effect are also related to aflatoxicosis. The target organs for aflatoxicosis are liver, kidney and immune organs. The best approach to reduce the effect of toxin is the use of nano adsorbent in feed. The adsorbents bind the toxin in feed and reduce absorption of toxin from GIT. The study will be focused on the cost effective synthesise and characterize of nano adsorbents using different techniques to control AFs.

**Objectives:**

- To evaluate the level of AFs contamination in poultry feed.
- To synthesise and characterize the nano adsorbents using different techniques.
- To evaluate the different physico-chemical effect of nano adsorbents on the reduction of AFs.

- To restore the quality of the products which in turn; prevent the post harvest losses and improve the nutritional status, thus protect the animal and human health.
- To improve income and health of farmer families and generate wealth in the crop value chain.
- To provide consultancy to exporters/importers of agricultural products, livestock and poultry feed industries.

**Present Status:**

- The level of AFs has been evaluated in poultry feed samples as collected from different poultry farms.

**Targets for 2019-20:**

- To synthesize low cost nano adsorbents.
- To apply the prepared nano adsorbents for the control of AFs in poultry feed.
- Commercialization of these products.

**Title:** **Development of a Natural Washing Liquid for the Disinfection of Non-Peelable Fruits and Raw Eaten Vegetables/Salad Vegetables.**

**Project Leader:** Ms. Anila Siddiqui, SSO

**Project Associates:** Dr. Abdul Basit Khan, SSO Dr. Zulfiqar Ali Mirani, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Fruits and vegetables become contaminated with the pathogenic microorganisms during cultivation, handling, processing, storage, transportation and at the point of selling. Consumption of such fruits and vegetables can cause serious microbiological infections. Washing solutions are being used in the developed countries of the world. For cleaning and disinfection, the use of chemical products are not desirable as they are not human friendly, so the development of a natural washing liquid is the aim of this project as such local product is not available in Pakistan.

**Objectives:**

- A survey to determine the microbiological quality of selected non-peelable fruits and raw eaten vegetables.
- To see the antimicrobial effects of natural food spices.
- Product development.
- Patent submission

**Present Status:** On-going

**Target for 2019-20:**

- Development of a human friendly natural washing liquid for the reduction of microorganisms in fruits and vegetables.

**Title:** **Studies on Biofilms Formation in Food Environments, Relationship of Pathogens and Non-Pathogens in Multi-Species Biofilms.**

**Project Leader:** Dr. Zulfiqar Ali Mirani, SSO

**Project Associates:** Mr. Korish H. Sahir, SO      Dr. Mohammad Naseem Khan, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

The aim of this project is to understand factors contributing to the biofilms formation in house refrigerators and food storage set-ups. Various bacterial species reside in domestic kitchens i.e. in water coolers and refrigerators, which are major means of food storage and can be a direct source of food borne illness. Majority of food borne pathogens is capable of adopting biofilm mode of growth, which help them to survive under unfavorable conditions. Biofilm formation enables bacteria to grow under unfavourable conditions, provides them protection and increases their resistance to antimicrobial agents. Biofilm formation in refrigerator or on food contact surfaces can result in spoilage of food. However, fungi and psychrotrophic bacteria are commonly associated with spoilage of food at refrigeration temperatures. Group of bacteria known as psychrotrophs e.g. *Listeria monocytogenes*, and *Yersinia enterocolitica* are capable of



growth under refrigerated temperature or below 10°C. Certain serotypes of *Bacillus cereus*, *Clostridium botulinum*, *Salmonella* spp., *E. coli* O157:H7 and *Staphylococcus aureus* may also grow slowly at refrigeration conditions. Therefore, the monitoring of microbiota in the refrigerator is important for food safety. In natural environment, most of the bacteria live in multi-specie biofilms. These biofilm consortia may harbour pathogen as well as non pathogen bacteria that influence each other in synergistic or antagonistic manner. In studies on biofilm, mostly targets are pathogens, while non-pathogens are totally ignored. According to recent study, mostly food borne bacteria, either pathogens or non-pathogens, are capable of forming biofilms and more importantly they have the ability to form multi-species biofilm, which are more stable and resistant to sanitizing agents. It is also possible that biofilm negative bacteria take shelter in biofilm consortia actually produced by others residing in same environment. Sometime these biofilm negative invaders may be fast growing and take over whole consortia and if these are pathogens it may result in health hazardous consequences.

#### **Objectives:**

- To study biofilm positive and negative bacteria into same consortia.
- To explore the role of non-pathogens in multi-specie biofilms.
- To study the relationships between multi-specie biofilm indwellers, whether they protect each other or antagonize. Target pathogens would be *Bacillus cereus*, *Clostridium botulinum*, *Salmonella* spp., *E.coli* O157:H7, *Staphylococcus aureus*, *Listeria monocytogenes*, and *Yersinia enterocolitica*.
- To isolate pathogens and study their relationship with non-pathogenic bacteria.
- To determine whether multi-species biofilms offer enhanced fitness compared to single-species biofilms.

#### **Present Status:**

- Two papers have been published through R&D on Biofilms.

#### **Targets for 2019-20:**

- Isolation of biofilm producing bacteria from food and water.
- Characterization and identification of isolates.
- Effect of physical and chemical factors on biofilm formation.
- Interaction of biofilm producers and non-producers in same niches.

**Title:** Isolation and Screening of Antimicrobial Fractions/ Compounds from *Acacia nilotica*, *Prosopis juliflora* and *Alstonia scholaris*

**Project Leader:** Dr. Nighat Sultana, PSO

**Project Associates:** Mr. Muhammad Saleem Qazi, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

There is urgent and continuous need to discover new antimicrobial compounds with diverse chemical structures and novel mechanisms of action because there has been an alarming increase in the incidence of new and re-emerging infectious diseases. Another big concern is the development of resistance to the antibiotics in the current clinical use. Higher plants produce hundreds to thousands of diverse chemical compounds with different biological activities. It is believed that these compounds have an important ecological role and could be used for the infectious diseases. The potential of these photochemical in managing infectious diseases has attracted considerable interest recently. This is believed to be due to their ability to affect the growth and survival of several human pathogens. Since these photochemicals are derived from natural sources, and generally recognized as safe and are rarely associated with any side effects as seen in many antibiotic regimens. It is of worth noting that although much of the research has been focused on the phenolics, terpenoids and alkaloids, but still there is need of further investigations to explore the novel skelta and their biological activities. Hence the current project has been designed to search potential antimicrobial compounds from the plants. Although much work has been focused to investigate the taxonomical work, however, the chemical diversity of a range of the plants still needs an extensive research. The *Acacia nilotica*, *Prosopis juliflora* and *Alstonia scholaris* will be studied for antimicrobial studies and the plant showing the required characteristics will be screened for the isolation, purification and characterization of the secondary metabolites.

**Objectives:**

- To isolate, identify and characterize the active ingredient of plants.
- The main objective of screening of antimicrobial compounds is to search new analogue of antimicrobial compounds with improved efficacy.

- To synthesize novel antimicrobial analogue which are less prone to resistance.
- 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.
- New inhibitors of microbe will be designed and then will be isolated/synthesized for antimicrobial studies to target the required new antimicrobial drugs.

**Present Status:**

- Phytochemical study of the aerial parts of *Acacia nilotica* utilizing liquid–liquid fractionation and different column chromatographic techniques resulted in the isolation of one triterpene
- Structure of the isolated compound was established through physical, NMR and MS data. Further column chromatography is in progress to increase the quantity of compounds. Alcoholic fractions and chloroform fractions showed good microbial activity. Known triterpenes and steroids have been isolated from *Acacia nilotica*.

**Targets for 2019-20:**

- Extraction of plants material.
- Biological and pharmacological studies of plant extract.
- Chemical study of extract and isolation of active principal.
- Data compilation.
- Patent / process / publication.

**Title:** Preparation of Value Added Products Utilizing Ash from Various Sources and Evaluation of the Properties of Finished Products

**Project Leader:** Dr. Naheed Kausar, PSO

**Project Associate:** Mr. Umair Ihsan, TO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Ash/fly ash is being very effectively and economically used in building components such as bricks, roads constructing material and embankments with some design changes. Ash from organic material can be converted to produce organic fertilizer, emulsifier, cleaning products and to treat/neutralized the effluents of textile and chemical industries as this organic waste is basic in nature and contain sufficient amount of carbon, Mg, S, P, Fe, Mn, and Cu. It can also be used in reinforced concrete construction since the alkaline nature will not crude steel. Organic silicon synthesized from fly ash had been tried to clean the sea water. In Pakistan, waste of boiler fuel and coal-based thermal power plants, “ash/fly ash” is discarded to the environment as a waste which cause environment pollution. This waste material can be shifted from “Waste Material” category to “Resource Material” category through development and application of technologies. The purpose of this project is to utilize the waste material of Pakistan based industries to develop economical feasible technical products as well as to reduce the environment pollution.

**Objectives:**

- Development of innovative and cost effective value added products utilizing waste of boiler fuel and coal-based thermal power plants , “ash/fly ash”.
- To reduce environment pollution.
- Process development/converting lab scale production to pilot scale/industrial scale production.
- Preparation of techno-economic feasibility reports of developed products.
- Profit generation to lease out the commercialized products.
- To promote and support cottage industries/peoples of Pakistan for establishing their own business.

**Present Status:**

- Two patents have been filed.
- A semi solid alkaline and wax-free cleaning as well as polishing composition for hard surfaces has been prepared using the extract of bagasse ash. The Patent entitled as, “Non-Wax and VOC Free Water Based Cleaning Composition for Hard Surfaces” has been submitted to IPO Pakistan (Ref: IPO Pakistan Patent Application Number 21/2019, Jan. 17, 2019).
- “A Process for Utilizing Bottom Ash of A Thermal Power Plant to Prepare Liquid Sodium Silicates of Required Strength” has been submitted to IPO Pakistan (Ref: IPO Pakistan Patent Application Number 657/2019; Oct. 03, 2019).

**Targets for 2019-20:**

- Preparation of innovative and cost effective value added product utilizing ash (waste of boiler fuel) and indigenous material.
- Evaluation of physical and chemical properties of developed value added products.
- Process development to prepare product on semi pilot/pilot scale to commercialize developed products.
- Commercialization of the value added products.
- Pilot/semi pilot scale production of the value added products as per client’s demand/need.

**Title:** **Studies on Chemical Constituents of *Ipomoea turpethum***

**Project Leader:** Dr. Rashid Ali Khan, SSO

**Project Associates:** Dr. Shazia Yasmeen, SSO    Dr. Sadia Ferheen, SSO  
Dr. Ghulam Fareed, JEO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

*Ipomea turpethum* is an important herb, used in ayurvedic system of medicine since ages. It is used internally to treat fevers, anorexia, edema, anemia, ascites, constipation, hepato-splenomegaly, hepatitis, intoxication, abdominal tumors, ulcers, wounds, worm infestation, pruritus and other skin disorders. Root is also administered to treat obesity, haemorrhoids, cough,

asthma, dyspepsia, flatulence, paralysis, gout, rheumatism, melancholia, scorpion sting, and snake bites. The paste of root powder of *I. turpethum* is used topically to treat vitiligo and other skin disorders, alopecia, cervical lymphadenitis, haemorrhoids, fistulas, ulcers and chancres. Oil extracted from the root bark is used in skin diseases of a scaly nature. A processed ghee with fresh juice of leaves is dropped into the eyes to treat diseases like corneal opacity or ulcer and conjunctivitis. Root powder mixed with ghee and honey is also used to treat hematemesis, tuberculosis and herpes. In spite of consistent use of *I. turpethum* in ayurvedic medicine since centuries, the herb is little known to the research community.

**Objectives:**

- Isolation and structure elucidation of pharmacological active components.
- Evaluation of enzyme inhibition activity of fractions and pure compounds.
- Their utilization in the development of various formulations related to pharmaceuticals, cosmetics.

**Present Status:**

- Extraction of 7 Kg of dried root with methanol (10 Lx 3) and evaporation on rota-vapour to give gummy residue.
- Fractionation between hexane, ethyl acetate and butanol soluble fractions
- Column chromatography of ethyl acetate soluble fraction
- Isolation of two secondary metabolites from ethyl acetate soluble fraction. Spectroscopy techniques confirmed that both are new.
- Both compounds showed significant biological activities (antifungal and antibacterial activities). They were also submitted for the evaluation of anti-oxidant activity but showed no significant activity.
- One paper has been submitted for publication.

**Targets for 2019-20:**

- Identification and characterization of further isolated compounds by spectroscopic techniques.
- Biological studies of these isolated compounds.
- Data compilation.
- Patent / process / publication.

**Title:** Isolation of Marker Compounds and Generation of Chromatographic and Spectroscopic Profiles of *Mucuna pruriens*, *Anacyclus pyrethrum* and *Withania somnifera*

**Project Leader:** Dr. Rashid Ali Khan, SSO

**Project Associate:** Dr. Shazia Yasmeen, SSO

**Year of Initiation:** 2018

**Duration:** 03 Years

**Background:**

The herbal supplement market has grown rapidly in recent years, the public is heavily scrutinizing the quality of available products. Always they have been concerned about the inconsistent composition of herbal medicines and occasional cases of intoxication by adulterants and toxic components. Chromatographic finger printing has been demonstrated to be a powerful technique for the quality control of herbal medicines. A chemical finger print is a unique pattern that indicates the presence of multiple chemical markers within a herb/extract. The European Medicines Agency (EMA) defines chemical markers as chemically defined constituents or groups of constituents of a herbal medicinal product which are of interest for quality control purposes regardless whether they possess any therapeutic activity. The quantity of a chemical marker can be an indicator of the quality of a herbal medicine. Chemical markers may be used at various stages of the development and manufacturing of a herbal medicine, such as authentication and differentiation of species, collecting and harvesting, quality evaluation, stability assessment, diagnosis of intoxication and discovery of lead compounds. Lack of chemical markers remains a major problem for the quality control of herbal medicines. In many cases, herbal product manufacturers do not have sufficient chemical and pharmacological data of chemical markers. Through this project methods will be developed to authenticate herbs and their quality. As a result, training and consultancy opportunities will be developed for herbal industries for the production of quality ensured herbal products.

**Objectives:**

- Extraction of medicinal herbs and chromatography to isolate marker compounds.
- Identification and characterization of marker compounds.
- Generation of finger print profile of herbal extract utilizing marker compounds.
- Optimization of process to isolate marker compounds.
- To build a bank of marker compounds.

- To generate library of finger print chromatographs.
- Documentation and publication of results.
- Creation of opportunity for the training and consultancy to herbal industries for the production of quality ensured herbal products.

**Present Status:**

- *Mucuna pruriens* Linn, *Anacyclus pyrethrum*, *Withania somnifera* have been selected, identified, grinded and crushed for extraction.

**Targets for 2019-20:**

- Extraction and chromatography of the above mentioned powdered herbs.
- Identification and characterization of marker compounds will be done by spectroscopic techniques.
- Finger print profiles of above mentioned herbal extracts utilizing marker compounds will be generated.
- Process will be optimized to isolate marker compounds.

**Title:** **To Study the Spread of Multi Drug Resistant Pathogenic Strains through Poultry Meat: A Potential Threat to Humans**

**Project Leader:** Dr. Kauser Siddiqui, SSO

**Project Associate:** Dr. Shagufta A. Shaikh, SSO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

The consumption of poultry products is increasing every year. Poultry and poultry meat are often found contaminated with potential pathogenic microorganisms such as *Salmonella*, *Campylobacter*, *Staphylococcus aureus*, *Escherichia coli* and *Listeria*. Occasionally *Yersinia enterocolitica*, *Aeromonas* and *Clostridium perfringens* have also been found to be the potential pathogen in poultry products. However, *Salmonella*, *Campylobacter*, and to a lesser extent *Listeria*, are also considered to be the major foodborne pathogens in the poultry industry. In poultry, the use of antibiotics facilitates their efficient production, and also enhanced the health



and well-being of poultry by reducing the incidence of disease, but unfortunately, edible poultry tissues becomes contaminated with harmful concentrations of drug residues which is very important source of concern among the public and medical health professionals. Many of the antibiotics used to treat bacterial infections in humans, also have veterinary applications since they are being used to treat infections in sick and injured animals and also as prophylactics and growth promoters. These antibiotics are used at lower concentrations which encourages the production of antibiotic resistant strains of bacteria along with allergic reactions and technological problems of fermented meat products. For example some antibiotics are directly toxic, e.g. chloramphenicol which cause fatal plastic anemia, allergic reactions and toxic side effects with fatal consequences. These residual antibiotics are also reported to be found in egg, milk, cheese, butter and other livestock products as well. This results in changes in human intestinal micro-flora and elimination of some useful bacterial strains. The severe disadvantage of use of antibiotics in poultry farming is the spread of antibiotic resistance among the human population *via* transferring the resistant strains and also residual antibiotics from animal to human population resulting in severity of disease in patients of all ages especially in children and elderly people which are immune compromised and more prone to the diseases.

**Objectives:**

- To find the residual antibiotics in poultry meat and to isolate the multi drug resistant strains which can be transferred to human population from meat and meat products.
- To help an analyzing the gravity of the spread of antibiotic resistance among the population and severity of prevalence of any endemic due to resistant pathogenic strain.

**Present Status:**

- Chicken meat samples including liver, kidneys, heart chest and leg pieces are purchased from different areas of metropolitan city, Karachi. The samples are processed for Isolation and detection of range of pathogenic bacteria. Detection of common poultry antibiotics in the meat samples of chicken for residual detection is being performed. Results are in compilation mode. Few more samples will be processed for obtaining significant data.

**Targets for 2019-20:**

- To detect the residual antibiotics in samples
- To isolate and purify the potential pathogenic microorganisms from poultry meat
- To check multiple drug resistance of the isolated pathogenic strains from poultry meat samples.

**Title:** Assessment of Synthetic and Natural Long Chain Molecules for Strengthening Antibiotics Against Resistant Bacteria

**Project Leader:** Dr. Salman Tariq Khan, SSO

**Project Associates:** Dr. Abdul Hafeez Laghari, SSO  
Dr. Zulfiqar Ali Mirani, SSO  
Mr. Muhammad Naseem Khan, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Bacteria which are able to survive in conditions set against them such as in preservatives or high concentrations of salt and sugar, become stronger to eradicate when they grow in biofilm modes which are aggregates of microbial cells surrounded by a matrix of exo-polymers. While the reason behind formation of biofilms may be multiple factors, including the age of the cell, attachment surface, bacterial cell surface properties, presence of other bacteria, temperature, availability of nutrients and pH. Existence and growth of the bacteria in biofilm mode causes release of planktonic cells thereby leading enhancement of reoccurrence in food making it 10 to 1000 times stronger. Having no standard treatment option to get control over biofilm bacteria communities, it is need to study on factors of biofilm formation. Besides that using different molecules to break such biofilm clusters to control over its resistance and making viable for eradication through antibiotics which otherwise become less or ineffective. Natural molecules and their synthetic analogous possess variety of functionalities and used for numerous purposes. In this project some selected long chain natural molecules will be isolated and/or synthesized to assess for their activity against biofilm. Previously cis-2-decanoic acid and cis-9-octadectanoic acid were successfully used against biofilm by other scientists. *Staphylococcus aureus* is an example of those which is considered hardiest bacteria. At present more long chain organic compound are to be tried to meet the above mentioned challenge.

**Objectives:**

- To control over bacteria grow in biofilm mode and become antibiotic resistant.
- Assessment of different natural as well as synthetic long chain molecules for ability to

break the biofilm.

- Decreasing the resistance of bacteria against antibiotics.

**Present Status:**

- Several trials have been made to break bio-films to minimize the resistance of bacteria.
- Selected bacteria for trial are *Staphylococcus aureus*, *Pseudomonas aeruginosa*.
- Ascorbic acid is capable to break the biofilms, however, long chain compounds increase its capacity.
- So far tried long chain compounds to break biofilms of above bacteria are Erucic acid, Methyl erucate, Octadecanoic acid, palmityl chloride.
- Along with ascorbic acid considerable synergistic effect of Stearic acid is observed, while other long chain compounds did not effect on biofilm in microbial media prepared during these trials.

**Targets for 2019-20:**

- Isolation of natural, synthesis and characterization of more long chain molecules for assessment of the above said activity.
- Different microbial media will also be assessed as some compounds are dependent on particular media to be active as antibacterial.
- Derivatization of active compounds (able to break biofilms) is also proposed with anticipation to increase the antibacterial activity.

**Title:** Preparation of Artificial Saliva for Symptomatic Relief in Xerostomia (Dry Mouth) and Stimulation for the Production of Natural Saliva

**Project Leader:** Dr. Kanwal Abbasi, SSO

**Project Associates:** Dr. Kauser Siddiqui, SSO Dr. Samina Iqbal, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Dry mouth (Xerostomia) is a chronic inflammatory disease where salivary glands fail to function adequately, due to desiccation of the intra-oral tissues. As a result there is insufficient saliva production in mouth to keep it wet. Saliva is needed not only to moisten and clean the mouth but also to prevent infections by fighting bacteria and fungi. A decreased in the flow of saliva is often associated with a number of secondary effects, namely hampered movements of the lips and tongue, masticator difficulties and disturbances in swallowing, speech and taste. Causes of dry mouth include medications, autoimmune disease (Sjogren's syndrome), radiotherapy or chemotherapy for cancer, hormone disorders and infections. Patients with chronic or temporary sensation of dry mouth need some kind of treatment to relieve the symptoms. Saliva contains a bacteriolytic enzyme called lysozyme, which is mucoprotein in nature. It also contains soluble polysaccharides like ABO specific blood group (agglutinogens) substances, enzymes like kallikrein and a protein component that acts as a nerve growth factor. Artificial saliva preparations are designed to mimic natural saliva both chemically and physically. It is expected to have a viscoelastic pattern similar to normal human saliva to provide similar viscosity and film forming properties. It does not stimulate natural salivary gland production and must be considered as replacement therapy and not as a cure for xerostomia (dry mouth).

**Objectives:**

- To prepare artificial saliva to relief the symptoms of xerostomia and also to stimulate the production of natural saliva.
- Comparative study to check that prepared artificial saliva is similar to natural saliva both chemically and physically.

- To study artificial saliva for its efficacy.

**Present Status:**

- Different formulations of artificial Saliva were prepared. The stability of active ingredient and the product at whole is in progress. The stability study at different temperatures is also performed.
- Microbial analysis is completed for initial stages and now the analysis is scheduled at different time interval till the end to evaluate the shelf life of the product.

**Targets for 2019-20:**

- Data evaluation for prepared artificial saliva.
- Comparison with internationally available artificial saliva.
- Preparation of multiple flavor saliva.
- Microbial and chemical analysis of artificial saliva with different types of preservative.

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

**Project:** PSF/Res/S-PCSIR/Chem (478)

**Principal Investigator:** Dr. Shahnaz Perveen, CSO

**Approval Date:** 2013

**Funds Released:** 2016

**Duration:** 03 Years

**Background:**

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. 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 the components of drugs including HIV protease inhibitors that are trypsin and  $\alpha$ -chymotrypsin to CCK- $\beta$  receptor and endothelin antagonist, antiulcer and they are also reported as inhibitors of acetyl and the most common usage is a medication taken to alleviate clinical depression or

dysthymia (milder depression). Several groups of drugs are particularly associated with the term, notably MAOIs and tricyclics. These medications are now amongst the most commonly prescribed by psychiatrists and general practitioners, and their effectiveness and adverse effects is the subject of many studies and competing claims. Hydantoin analogues (heterocyclic organic compounds) have been identified as anticancer, anti-convulsants, anti-inflammatory, anti-HIV, anti-diabetics, anti-muscarinics, anti-ulcers and anti-arrhythmics, anti-hypertensive, serotonin and fibrinogen receptor antagonists, inhibitors of the glycine binding site of the NMDA receptor and antagonists of leukocyte cell adhesion acting as allosteric inhibitors of the protein-protein interaction. Diphenylhydantoin (DPH) and its analogs exerted an inhibitory effect on the Neuronal Voltage Sodium Channel (NVSC) and are anti-MES. Hydantoin and thiohydantoin derivatives have capacity to penetrate the blood-brain barrier, hence provide an anti-convulsant activity against generalized tonic-clonic seizures. Still more research is required for the innovation of novel compounds as drug candidates with fewer side effects.

**Objectives:**

- Syntheses of 50-100 different urea derivatives, di-thin, hydantoin 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 clinical trial in concern laboratories based on availability of funds.

**Present Status:**

- Eighteen derivatives of succinamic acid were synthesized by treating succinic anhydride with different primary aliphatic and aromatic amines.
- Sixteen derivatives of di-thin di-isoimide were prepared by treating succinamic acid derivatives with thionyl chloride.
- Ten (10) compounds of di-thin di-isoimides having zone of inhibition (17-23 mm) showed very good activity against *E. coli* (Gram negative bacteria), except two, all compounds are active against *E. coli* MDR, whereas standard Gentamicine is inactive, so these compounds can be used in future for treatment of *E. coli* MDR infections. Most of the compounds are active against *K. pneumonia*.
- Twenty seven derivatives of hydantoin were synthesized from potassium cyanide and by the reaction of ammonium carbonate with various aldehydes and ketones.
- Thirty seven derivatives of benzenesulfonyl hydrazone are synthesized, twenty two (22) compounds are evaluated for their *in vitro* anti-leishmanial activity. Six compounds, showed good anti-leishmanial activity. These compounds can therefore be served as lead

compounds for further studies in this field. Eight compounds showed moderate anti-leishmanial activity.

- **Publications:**

1. Antibacterial and antifungal activities of 5-arylidene-*N,N*-dimethylbarbiturates derivatives, Khalid M. Khan, M. Khan, A. Ahmad, A. Irshad, L. B. S. Kardono, F. Rahim, S. M. Haider, Sumbul Ahmed and Shahnaz Perveen, *Journal of The Chemical Society of Pakistan*, 36 (6), 1153-1157, 2014.
2. Di-thins di-isoimide: Synthesis and their Antibacterial, Antifungal Studies, Sumbul Ahmed, Shahnaz Perveen, Khalid M. Khan, Rahat Azher Ali, Munazza Ajaz, Samreen Shah, *Pakistan Journal of Pharmaceutical Sciences*, Accepted, 2019.

- **Graduate Degree:**

1. Research Associate, Ms. Sumbul Ahmed appointed in this PSF project, had completed her Ph. D. The Vice Chancellor on behalf of the Academic Council & Syndicate, has approved the award of Ph. D. degree in chemistry on 3<sup>rd</sup> July 2017.

**Target for 2019-20:**

- Synthesis of 15 to 20 or more heterocyclic organic compounds (urea derivatives) will be carried out and will be evaluated for their biological activity.

**Title:** **Production of Highly Potential Standardized Herbal Extract for Various Herbal Formulations**

**Project Leader:** Dr. Nighat Sultana, PSO

**Project Associates:** Mr. Muhammad Saleem Qazi, SSO  
Mr. Mahmood-ul-Hassan, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Drugs Regulatory Authority Pakistan (DRAP) has issued 636 licenses to different local and multinational Herbal companies. There is only one herbal company in Pakistan that is working on herbal extracts and fulfills the requirements. However mostly these companies are importing herbal extracts from China, India etc. Even Pakistan has been earning around \$1.5 billion annually through export of herbal medicines, which could be raised five times if the local herbal companies are patronized and work on scientific basis. Mostly local companies are manufacturing their product by decoction procedure. It has been observed that over 30,000 herbal medicine and cosmetic production companies are operating in the country and manufacturing their product by decoction procedure or importing herbal extract. There are many potential herbal extracts imported in the country but some of that important herbal extracts can be produced locally for the valuable industrial use by *Adhatoda vasica*, *Glycyrrhiza glabra*, *Piper longu*, *Viola odorata*, *Alpinia galangal*, *Alstonia scholaris* etc.

**Objectives:**

- To extract the bioactive compounds of *Adhatoda vasica*, *Glycyrrhiza glabra*, *Piper longu*, *Viola odorata*, *Alpinia galangal*, *Alstonia scholaris*.
- To isolate, identify and characterize the active ingredient of plants with the help of UV Spectroscopy, HPLC, GC and Infra red Spectroscopy.
- To initiate process of drug discovery and development by using practical approach of extraction of bioactive compounds/extracts.
- The main objective of extraction of bioactive compounds is to search new analogue of bioactive compounds with improved efficacy.
- To develop new techniques and method for bioactive extraction of metabolites.



**Present Status:** New project

**Targets for 2019-20:**

- Extraction of plants materials and their standardization.
- Biological and pharmacological studies of plant extract.
- Chemical study of extract and isolation of active principal.
- Patent/process/publication/herbal formulations.
- To synthesize novel bioactive analogue which are less prone to resistance.
- To provide longer duration of action with minimum side effects.

**Title:** Soluble Fertilizer Formulations of Organometalic Complexes for Foliar Feeding

**Project Leader:** Dr. Amir Ahmed, SSO

**Project Associates:** Ms. Rehana Jafri, PSO Dr. Kamran Ahmed Abro, SSO  
Mr. Irshad Ahmed Khan, EO

**Year of Initiation:** 2019

**Duration:** 03 Years

**Background:**

Fertilizers are added to the soil or foliage of crops to supply elements needed for plant nutrition. Typically, Nitrogen (N), Phosphorus (P) and Potassium (K) are the principal components of such fertilizers, while micronutrients replenishment has seldom done. Fertilizer formulations and methods are the subject of ongoing research, in order to improve the growth stimulating and stress tolerance effect on the plants. Additionally there are ongoing efforts to reduce the amount of fertilizer required for application to plants, to avoid leaching of nitrogen and phosphate into the ground water. Thus there is a need for new fertilizer formulations and new methods of fertilizer application which can be applied as a foliar product. Foliar feeding constitutes one of the important milestones in the progress of agricultural crop production. Ionic preparations of fertilizers are acidic in nature, which are injurious to plants. Organic complexes forms of mineral fertilizers are neutral or alkaline which are readily assimilated by plants. For this reason these preparations have assumed great importance these days and are in great demand.

**Objective:**

- Preparation and evaluation of new foliar fertilizer based on organic mineral complexes.

**Present Status:** New Project

**Targets for 2019-20:**

- Process/product development on lab scale for preparation of fertilizers based on organic mineral complexes for foliar application.
- Evaluation of the products.
- Scale up the process to pilot scale.
- Commercialization of the product.
- Patent/paper submission.

**Title:** Extraction, Purification and Characterization of Maltase Enzyme from Seedling of *Pisum sativum* Seed for Starch Processing

**Project Leader:** Dr. Saeeda Bano, SSO

**Project Associates:** Dr. Kauser Siddiqui, SSO Dr. Samina Iqbal, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Maltase or alpha glucosidase (EC 3.2.1.20) is an exo-glycosidase that catalyzes the release of  $\alpha$ -D-glucose from the non-reducing end of substrates. Plant maltase is extensively used in biotechnology and has important applications in food and pharmaceutical industries such as the production of glucose syrup and in brewing industry. The enzyme is responsible for the final step in starch processing industry. In addition, it is also used in  $\alpha$ -amylase assay kits in clinical laboratories and synthesis of oligo-, di-, and tri-saccharides. Maltase had been purified to homogeneity from different plants such as rice, buckwheat, sugar beet, spinach, and pea to know its possible role in these plants. In plants, maltase is important multi-functional enzyme mainly catalyzes the hydrolysis of oligosaccharides produced from starch to yield glucose that serves as an energy source for the developing plant. Apart from it, maltase could also initiate the

degradation of natural starch granules in pea (*Pisum sativum*) chloroplasts and barley seeds in the absence of  $\alpha$ -amylases. To stop the degradation of natural starch maltase inhibition is required. Viewing the maltase inhibition scenario, a large number of maltase inhibitors isolated from the plant are being used as anti-diabetic drugs for diabetes mellitus Type II. Therefore the extraction, purification and characterization of maltase enzyme from *Pisum sativum* will be very much beneficial and purification of the enzyme will enhance its acceptability in nutraceutical and pharmaceutical enzyme industry as well as starch processing industries.

**Objectives:**

- Extraction of crude maltase from seedling of *Pisum sativum*.
- Optimization of extraction condition for enhanced production.
- Partial purification of enzyme using different precipitating agents.
- Physiochemical properties studies of maltase enzyme.
- Purification and characterization of maltase enzyme.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Extraction of crude maltase from seedling of *Pisum sativum*.
- Optimization of extraction condition for enhanced production.

**Title:** **Cholesterol-Lowering Effect of Medicinal Plants (*Pyrus cydonia* and *Aegle marmelos*) in Animal Model**

**Project Leader:** Dr. Tehmina Sohail, SSO

**Project Associates:** Dr. Hina Imran, SMO          Dr. Atiq-ur-Rahman, PSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Hypercholesterolemia is well known risk factor for the development of cardiovascular diseases including atherosclerosis, myocardial infarction and cerebral paralysis. Body makes all the cholesterol from diet and animal sources. Increase in cholesterol levels (hypercholesterolemia) have significant health concern in recent years. Curing hypercholesterolemia without any side effects remains a challenge for modern medicine. Due to the side effects of these medicines people are looking for safe alternatives and the search for new drugs which are capable of reducing and regulating serum cholesterol levels. Hence the aim of this study is to explore the hypocholesterolemic activity of indigenous medicinal plants for the health.

**Objective:**

- On the basis of cholesterol lowering effects of plant extracts, the product will be formulated with less side effects and process will be commercialized.

**Present Status:** New Project

**Targets for 2019-20:**

- Extraction of plant material.
- Phytochemical screening of plant material.
- Cholesterol lowering assay in animal model.
- Data compilation.
- Publication / Patent / Process.

## **PCSIR Laboratories Complex, Lahore**

**Title:** Development of Process for the Production of Dot 3 Brake Fluid

**Project Leader:** Dr. Zafar Iqbal, SSO

**Project Associates:** Dr. Abdul Qayyum Ather, PSO  
Mr. Mohammad Usman Sabri, SO  
Mrs. Mubeen Akhtar, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

### **Background:**

Brake fluid is a type of hydraulic fluid used in hydraulic brake and hydraulic clutch applications in automobiles, which operates under high temperature and pressure. Initially, castor oil and mineral oil-based brake fluid has been used then followed by glycol-based products. Glycol-based brake fluids show very good friction behaviour and are inherently excellent lubricant due to high polar nature that gives a strong affinity to metal. Glycol based brake fluids are typically used in vehicles with antilock brake system (ABS) and known as DOT 3.

### **Objectives:**

- To develop glycol and glycol based brake fluid DOT 3 for automobiles.
- The developed process and product will be evaluated.
- To produce this product locally for catering the need of our automotive industry.

**Present Status:** On-going

### **Targets for 2019-20:**

- The extensive literature survey will be made and their composition and ingredients will be studied in detail.
- The products already in the market will be evaluated for their physical and chemical parameters.
- To develop the process and product to meet the international standard specification on small scale.
- Physical and chemical evaluation according to standard specifications.
- Commercialization of the product.

**Title:** Development of Skin Whitening Agents for Inhibition of Melanin Activity and its Application in Cosmetic Products

**Project Leader:** Ms. Hifza Akhtar, PSO

**Project Associate:** Dr. Abdul Qayyum Athar, PSO

**Year of Initiation:** 2019

**Duration:** 1.5 Years

**Background:**

Visible pigmentation in human results from the synthesis and distribution of melanin pigment in the skin. Accumulation of high level melanin causes the darkening of skin and is not considered cosmetically pleasing affect. Moreover, high level of melanin is also characteristic of a great number of diseases including melasma, solar lentiginies and post inflammatory hyper pigmentation, thus increasing desire for skin whitening agent not only to satisfy the cosmeticological look but also necessary to address the skin problems as well. Many compounds including hydroquinone, mercury salt are used as skin agents to lighten skin colour but their effects on skin are so drastic and harmful that these compounds recommended to be banned. So, exploring and developing the whitening agents is the important requirement of the time.

**Objective:**

- To develop skin friendly whitening agents which have the ability to penetrate well in skin and bind the tyrosinase (compound that produces melanin in human body) active site to inhabit melanin synthesis.
- To develop whitening agents to the capacity to moisturize the skin surface and protect from the ultra violet rays.

**Present Status:** On-going

**Targets for 2019- 20:**

- To convert the research activity into commercial activity by developing low cost skin friendly full range of whitening cosmetic products.
- Improvement in the products so get results in short period of time without addition of any harmful chemical.

**Title:** Method Development and Validation of the Selected Herbicides Residual Determination in Mango.

**Project Leader:** Dr. Rabia Nazir, SSO

**Project Associate:** Ms. Shafaq Mubarak, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

With the rise in pest attacks and development of resistant pest strains, the farmers opt for unscrupulous use of pesticides to control pest attacks. This lead to enhanced level of residual pesticides in the produce making and it is also unfit for human consumption and posing stringent export restriction under WTO regime. Hence, to enhance the exports, it's mandatory for Pakistani exports to get test reports of their produce related to residual pesticide analysis. For this the exporters spend ample amount of money to pay testing fees in the country of import or any other foreign origin lab which is maintaining ISO-17025 accreditation. Considering this PCSIR Labs Complex, Lahore has established Pesticide Residue Lab which is already accredited for the scope of 9 pesticides under ISO-17025 and helping orange exporters. On the request of Punjab Agriculture Department, this lab is pursuing for its scope extension in domain of Mango. Hence, the project is initiated to develop the said facility to help Mango exporters for getting timely and quality analysis of their produce by providing them ISO-17025 accredited lab test report.

**Objectives:**

- Method development for the residual pesticides/herbicides estimation in Mango.
- Method validation for the residual pesticides/herbicides estimation in Mango.
- Establishment of facilities for the residual pesticides/herbicides determination for Mango growers and exporters.

**Present Status:**

- On the request from Punjab Agriculture Department, the initial process for arranging the required pesticides and herbicides is in progress.

**Target for 2019-20:**

- Development of ISO-17025 accredited facilities for the determination of residual pesticides in Mango.

**Project:** Development of General Purpose Surface Cleaners

**Project Leader:** Dr. Muhammad Zia-ur-Rehman, PSO

**Project Associate:** Mahroze Ahmad Khan, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Clean surfaces are fundamental to the control of pathogenic micro-organisms. The contamination of any product (food or medicinal) either through direct or indirect contacts with insanitary surfaces potentially compromises the safety of the product for consumption. The effectiveness of the cleaning and sanitation program relates to the efficient cleaning products. Cleaning formulations market is one of the largest product categories of the household cleansing market of Pakistan. The cleaning market has been further segmented into miscellaneous items like glass cleaners, general purpose cleaners and industrial cleaners. Growing awareness, easier access to range of products through organized retail formats and changing life styles have been the key growth drivers for the sector with even rural households starting to display preference for safe cleaner products instead of phenyl and acids which facilitated further expansion of this industry in Pakistan. Furthermore market is propelled by growing awareness of sterilization and disinfection technologies in all end-user markets, growing need to minimize.

**Objectives:**

- Study and selection of different suitable/ economical ingredients.
- Development of products and their physicochemical characterization.
- Quality assurance of product by means of practical applications.

**Present Status:** New Project

**Targets for 2019-20:**

- Literature survey.
- Procurement and quality assurance of chemicals/ raw materials/ equipment/ glassware.
- Initialization of formulation of products.



- Optimization of formulation conditions.
- Physicochemical analysis of products.
- Practical application of report writing/documentation.

**Title:** Development of Over Coat for Decor Printing

**Project Leader:** Mr. Ehsan ul Haq, SSO

**Project Associate:** Mr. Hamood ur Rehman, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Heat transfer paper has been used to transfer the image from the transfer paper to a receiving substrate. Such paper is coated with polymeric material which transfers the image on the substrate or object. For example, a user may transfer an image on a paper to a garment, such as a T-shirt etc. by applying heat to the transfer paper. Once the transfer paper has reached the required temperature and the image on the paper will be transferred to the garment. Now a days this technique is also being used in decorative ceramic materials.

**Objectives:**

- To develop the image transferring method by using indigenous technology.
- To provide a thermal transfer paper that has excellent colour printing formation, prevents spreading of ink and thus has an improved resolution.
- To provide the import substitution and save foreign exchange.

**Present Status:** On-going

**Targets 2019-20:**

- Procurement of chemicals.
- Preparation of product at lab. scale.
- Third party evaluation.
- Transfer of technology to local industry.

**Title:** Development of Silicone based Antifoaming Agent

**Project Leader:** Mr. Atif Latif , SO

**Project Associate:** Mr. Hamood ur Rehman, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Generally a defoamer is insoluble in the foaming medium and has surface active properties. An essential feature of a defoamer product is a low viscosity and a facility to spread rapidly on foamy surfaces. It has affinity to the air-liquid surface, where it destabilizes the foam lamellas. This causes rupture of the air bubbles and breakdown of surface foam. Entrained air bubbles are agglomerated and the larger bubbles rise to the surface of the bulk liquid more quickly. Silicone based defoamers are polymers with silicon backbones. These might be delivered as an oil or a water based emulsion. The silicone compound consists of an hydrophobic silica dispersed in defoamer. Emulsifiers are added to ensure that the silicone spreads fast and well in the foaming medium. The silicone compound might also contain silicone glycols and other modified silicone fluids. These are also heavy duty defoamers and are good at both knocking down surface foam and releasing entrained air. Poly dimethyl siloxane is a widely used antifoaming agent. These antifoaming agents are frequently using in textile, paper & pulp and other industrial process.

**Objectives:**

- To develop the antifoaming agent by using indigenous technology.
- Transfer of technology to local industry.
- To provide the import substitution and save foreign exchange.

**Present Status:** On-going

**Targets 2019-20:**

- Procurement of chemicals.
- Optimization of reaction conditions.
- Preparation of product at lab. scale.

- Third party evaluation.
- Lease out the process to local industry.

**Title:** **Pectin Production from Mango Peels; A Potential Replacer of Gelatin for Food Industry**

**Project Leader:** Dr. Sania Mazhar, SSO

**Project Associates:** Dr. Quratulain Syed, SSO      Dr. Naaz Abbas, SSO  
Dr. Ijaz Ahmed, PSO      Dr. Shahid Masood, SSO

**Years of Initiation:** 2019

**Duration:** 03 Years

**Background:**

Gelatin is widely used as a food ingredient in the food industry. However, it is reported that 99% of the gelatin source is pig skin, cattle bones and cattle hide. The increasing demands for non-mammalian gelatin for halal food markets have revived interest in pectin production from peels as well as pulp of fruits and vegetables. Pectin can be used in foods (jam, jellies, yogurt, pastries, juices etc.), as their structures can yield a variety of gelling, thickening, binding and stabilizing abilities. Pakistan is blessed with varieties of fruits and vegetables. However, Pakistan relies heavily on imported pectin due to the absence of technology to produce it locally. Moreover, with the increase in production of processed fruits and vegetables products, the amount of waste peels are increasing enormously. Thereby, the need is to effectively recycle peels waste by manufacturing useful and value added end products like pectin for food industries.

**Objectives:**

- Process development for production of mango pectin.
- Production of technically and economically feasible products.
- Solid wastes reduction by converting mango peels into a valuable industrial product.
- Human Resources Development (HRD) along with self-reliance of industries and economic growth of country.

**Present Status:** On-going

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**Targets for 2019-20:**

- Process development.
- Utilization of produced pectin in food products like jam, jellies, yogurt, pastries, juices etc.
- Lease out of the process.

**Title:** **Development of Thermal Shock Resistant Coatings on Piston Head by Thermal Spraying Technique**

**Project Leader:** Engr. Muhammad Irfan, SE

**Project Associates:** Engr. Badaruddin Soomro, JE  
A. Karim Aziz, TO  
Mr. Salman Ahmad, Tech.

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Combustion engine needs to improve its thermal efficiency and to mitigate green-house effects. In the case of diesel engines, increasing the mean effective cylinder pressure is a practical way to improve thermal efficiency. Higher mean effective pressures cause higher thermal and mechanical loads on the engine pistons. Damage mechanisms have different origins and are mainly wearing, temperature and fatigue related. Among the fatigue damages, thermal fatigue and mechanical fatigue, either at room or at high temperature play a prominent role. Thermal spraying technology is widely used in the production of ceramics and metallic coatings on metallic materials in the form of powders, rod and wire. Among these techniques, Air Plasma Spraying techniques have vital role in the development of such type of shock resistant coatings being used at high temperature applications. In this study, the different types of ceramic coatings will be applied on piston head for resistance of high temperature applications.

**Objectives:**

- Development of thermal shock resistant coatings to be used upto temperature of 1200°C.
- Characterization of developed coatings.

**Present Status:** On-going

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- Alumina ceramics coating is developed on piston head by Air Plasma Spraying technique

**Target for 2019-20:**

- After development of coating, the complete characterization will be carried out at high temperature to meet the required applications.

**Title:** **Development of Facilities for Production/Synthesis of Metal Matrix Composites**

**Project Leader:** Engr. Haris Ikram, SE

**Project Associates:** Engr. Muhammad Irfan, SE Engr. Farooq Iftikhar, JE  
Engr. Ahmed Raza, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

In past few years, Metal Matrix Composites Materials (MMC's) have gained a lot of attention and they have frequently been researched and developed due to the ability to tailor the properties (i.e. mechanical, electrical, magnetic and thermal properties) through reinforcement addition. MMC's have found their applications in tool industry, automobile industry for making engine cylinder liners, pistons and disk brakes, electronic industry for making high thermal conductive heat sinks, aerospace industry, sports industry etc. Various techniques have been employed for production of metal matrix composites; broadly they can be classified as: (1) solid state, (2) liquid state, (3) semi-solid, (4) vapour phase deposition and (5) *in-situ* processing techniques. Stir casting belongs to liquid phase processing techniques involving stirring of molten metal during reinforcement addition. Development of in-house production facility for MMCs will enable PITMAEM to synthesize a wide variety of MMCs through stir casting technique. Once the facility is developed, relevant industries will be approached in order to facilitate the needs of local industries for development of advanced materials.

**Objective:**

- To develop facility for production of Metal Matrix Composites through stir casting technique.

**Present Status:** On-going

**Target for 2019-20:**

- To start production of Metal Matrix Composites (aluminium based) of various compositions after completion of the proposed setup.

**Title:** **Adsorption of Bovine Serum Albumin to Modify Titanium Surface for Biomedical Applications**

**Principal Leader:** Engr. Bilal Waseem, JE

**Project Associates:** Ms. Farzana Habib, PSO Ms. Sumera Nosheen, SO

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Metals such as Co-Cr alloys, stainless steel, nitinol and titanium alloys have been in service since last few decades. Titanium implant is widely used in dentistry because of its extraordinary bio-compatibility and mechanical properties. The tissue integration of titanium surface plays a key role in the long term clinical success. Among titanium alloys, pure titanium and Ti-6V-4Al are suitable for bio-medical applications due to their non-toxicity and formation of oxide layer. Scientists have reported the bio-compatibility of these alloys in various environments like simulated body fluids and albumin serum. Growth of layers and adsorption of proteins on implant surface is of vital importance for bio-medical applications.

**Objectives:**

- Investigation of protein adsorption on titanium in Bovine serum by SEM, AFM, and FTIR.
- Investigation of protein adhesion and cell growth on titanium surface.

**Present Status:** On-going

**Targets for 2019-20:**

- To study the bio-compatibility of titanium metal *via* protein adsorption process and its comparison with other surgical grade metals.

**Title:** **Development of Aluminum Alloy 2024 and Optimization of Mechanical Properties through Heat Treatment**

**Project Leader:** Engr. Muhammad Irfan, S.E

**Project Associates:** Engr. Farooq Iftikhar, JE      Engr. Muhammad Nouman, JE  
Engr. Ahmed Raza, JE      Mr. Saad Ayyub, ST

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Over the past few decades due to the need of improving the fuel efficiency of aircrafts, researchers are working on materials that are light in weigh and have high strength. Aluminum alloys have been widely used in aerospace industry due to their high strength to weight ratio. 2024 is alloy of aluminum with copper as a primary alloying element. It is used in applications, where high strength to weight ratio and good fatigue resistance are required. It offers high strength, good work ability and fair machinability. Heat treatment of this alloy produces such structures which make this material ideal for aerospace industry as it improves the mechanical properties. This alloy is widely used in critical aerospace components such as fuselage structures, wing tension members, shear webs and ribs, where stiffness, fatigue performance and good strength are required.

**Objective:**

- To develop aluminum alloys in Pakistan to lessen the burden on economy.

**Present Status:**

- In the first stage of project aluminum alloy 2024 has successfully been developed.
- Optimization of the heat treatment parameters for this alloy is in progress to produce it locally for use in aerospace industry.

**Target for 2019-20:**

- Development of aluminum alloy 2024 and optimization of mechanical properties through heat treatment.

**Title:** **Development of Polymer Hybrid Nano Composites Shielding as Radar Absorbing Materials**

**Project Leader:** Engr. Muhammad Irfan, SE

**Project Associates:** Engr. Ibrar Ahmed, JE      Engr. Abdul Qadeer, JE  
Engr. Badaruddin Soomro, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Owing to extended use of electronics, wireless communication and automation, the EM radiations has increased tremendously in the work space. This EM radiation can further interfere with precise electronic equipment and may adversely affect its efficiency, energy consumption, and sudden break down of the process. EM interference (EMI) is the only concern behind restricted use of wireless communication devices in automation center and on board flight. In order to avoid these serious consequences, various agencies have recommended standards for electromagnetic compatibility (EMC). EMC is the ability of equipment or shield, which can avoid interference of emitted radiation within itself or with other equipment. Therefore, equipment must meet all requirements for EMC standards. In order to fulfill the commercial requirements different polymer based nano-composites were designed. Due to their unique properties like easy moulding, flexibility, cost effectiveness and tailored functional properties, polymer nanocomposites are used in almost all commercial sectors. Two main mechanisms of shielding i.e. reflection and absorption have been identified although for thinner shields multiple scattering becomes dominant. The reflection is a result of impedance mismatch between air and surface of the shield. Though reflection enhances the total microwave attenuation, it is not desirable due to increased pollution, interference with other equipment and health hazards. Extensive efforts are required to design impedance close to that of air of the shield. This allows penetration of EM radiation into the shield. Henceforth, properties like permittivity and permeability play a vital role in absorption of EM waves that penetrates into the shield.

**Objectives:**

- Preparation of magnetic nano particles for polymer nano composites.
- Synthesis of polymer nano composites for EMI shielding.



**Present Status:**

- Initial trials and characterization are being carried out.

**Target for 2019-20:**

- Development of RAM and optimization of shielding properties.

**Title:** **Fabrication of Smart Energy Storage Devices by Super Capacitive Effect**

**Project Leader:** Mr. Zaheer Abbas, SO

**Project Associates:** Engr. Jehanzaib Anwar, JE Engr. Hamza Butt, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

With growing demand of energy, There is need of smart devices which can store energy for longer time and we can use it in areas or equipments, where direct supply is not feasible for example portable electronic devices, electric cars and many more. Currently batteries are being used for energy storage in portable devices. But the problem with batteries is slow charging time and low life. Most of the batteries being used can perform it best up to 1000 cycles. To solve this problem researchers are putting their efforts to use capacitors as an energy storing devices. Using capacitors can solve both problems that is with batteries. These types of capacitors are known as super capacitors. They have very high capacitance which is increasing with every coming day. Due to their high capacitance they have replaced batteries in many applications like transportation, high speed travelling, ultrafast switching, mobile phones energy backup, uninterrupted power supplies etc. Salient features of these devices are compared in the following latest Lithium-Ion battery.

<b>Feature</b>	<b>Li-ion Battery</b>	<b>Super capacitor</b>
Power density (W/kg)	1,500	3,000 - 40,000
Cyclability (nb recharges)	500 - 1,000	500,000 - 20,000,000
Life	5 - 10 years	10 - 20 years
Self-discharge (% per month)	2	40 - 50 (descending)
Risk of explosion	yes	No

**Objectives:**

- Tailoring their properties for the enhancement of capacitance.
- Compatibility of electrodes with suitable electrolyte.
- Fabrication of device.

**Present Status:**

- Initial trials and characterization are being carried out.

**Target for 2019-20:**

- Development of super capacitor prototype for device fabrication.

**Title:** **Ecological Assessment of Shopping Bags for the Evaluation of Claim “Degradable / Oxo-Biodegradable / Environment Friendly” Used in the Local Market**

**Project Leader:** Dr. Farzana Bashir, SSO

**Project Associates:** Dr. Muhammad Irfan, SSO Mr. Javed Iqbal, SO

**Year of Initiation:** 2019

**Duration:** 1.5 Years

**Background:**

Plastic bags are common means of carrying grocery. After being used to carry goods from retailers to homes, most of the bags are disposed of or stored for reuse; in either cases they eventually reach the landfills. So the understanding of their ultimate fate in the environment is necessary for environment sustainability. Many chain stores in the Pakistan have introduced degradable/bio-degradable plastics and suggested consumers to avoid conventional plastic shopping bags. Plastic bags are appearing on the market with the claim of being “environmentally-friendly”, “degradable”, or “-bio-,” “green” etc. For an average consumer these claims can be quite “misleading”. Many doubts have been expressed as to whether these products can provide what they promise. The objective of this study is to evaluate and compare the bio-degradability of the product and labelled as degradable/bio-degradable.

**Objectives:**

- To create facilities in the Environment Laboratory to perform the bio-degradability testing.

- To evaluate the Oxo biodegradability of plastic bags available in the market and claimed as degradable/ Oxo-biodegradable.

**Present Status:** New project

**Target for 2019-20:**

- Comparison of biodegradation rates of ‘single-use’ plastic bags available in the market.

**Title:** **Evaluation of Bioactive Biomolecules to Manipulate the Plant Mediated Synthesis of Nanoparticles for Enterprising Biological Applications**

**Project Leader:** Engr. Dr. Muhammad Irfan, SSO

**Project Associate:** Dr. Farzana Bashir, SSO

**Year of Initiation:** 2019

**Duration:** 1.5 Years

**Background:**

The field of nanotechnology has witnessed outstanding growth in the past decade due to attractive application in environment, biomedical dyes degradation, catalysis, antioxidant, anti-cancer and antibacterial activities, water and waste water. However, all of these properties are highly dependent on particles size, shape and surface properties of nanoparticles. There are many bioactive molecules like amides, phenols, organic acids, flavonoids and proteins present in the plants which have dual nature for reduction of metal ions following by capping of surface of nanoparticles to provide stable metal nanoparticles. However, it is challenging so far to pin down a unique biological group that is actually used for bio-reduction of metallic precursor. Therefore, identification of particular bioactive molecule is mandatory to manipulate the size, shape and surface properties of nanoparticles to employ into numerous applications particularly in wastewater treatment and biomedical. Moreover, this project will be quite beneficial to develop a new route to reduce the massive quantity of various bio-waste materials generating every year. This project offers a promising pathway for effective implementation of ‘waste-to-valueable’ concept and conversion of solid waste of agricultural industry into industrial products that would add value to crop.

**Objectives:**

- To identify the presence of various phytochemicals present in plant extract.
- Identification of active biomolecules responsible for bio-reduction of metallic cursor for synthesis of nanomaterial.
- Study the effect of process parameters to tune the size and morphological properties of nanomaterial.
- To study the role of synthesized silver nanoparticles for antibacterial and water treatment applications.

**Present Status:** On-going

**Target for 2019-20:**

- Identification of key phytochemicals with remarkable properties to act as bio-reductant and bio-stabilizers for metallic nanoparticles, synthesis of nanoparticles, stability of synthesized nanomaterial along with identification of process parameters to tune the size and shape of nanomaterial.

**Title:** **Process for Preparation of Sodium Stibogluconate from Indigenous Stibnite.**

**Project Leader:** Dr. Irfan Hafeez, SSO

**Project Associate:** Ch. Athar Amin, PE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

In Pakistan ore of antimony occurs in Kharan district, salt range of Krinj in Chitral division, Kurram agency, Khuzdar, and Qilla Abdullah. In our country a little bit of mining has been confirmed in these areas. Previously PCSIR Laboratories/Centres worked on beneficiation and extraction of antimony metal and development of its derivatives using indigenous ore. Now R&D has been initiated on sodium stibogluconate synthesis. Sodium stibogluconate is a medicine continuously using for the treatment of leishmaniasis and is available only in the form of pentavalent antimonial injection. It has chemical formula  $C_{12}H_{35}Na_3O_{26}Sb_2$ . It is also being investigated as an antitumor agent.

**Objective:**

- To develop a new process for preparation of Sodium Stibogluconate using indigenous stibnite.

**Present Status:** On-going

**Targets for 2019-20:**

- Procurement and evaluation of antimony ore.
- Leaching for extraction of antimonial contents.
- Purification of antimonial extract.
- Bench scale R&D on utilization of antimonial extract for preparation of sodium stibogluconate.
- Optimization of parameters regarding the recovery and grade of end product.
- Evaluation of end project.
- Report writing.

**Title:** **Process Development for the Beneficiation of Indigenous Iron Ore of Tharparker Area, Sindh Province, Pakistan**

**Project Leader:** Mr. M. Arif Bhatti, SSO

**Project Associates:** Mr. Ansar Mehmood, SSO    Engr. K. R. Kazmi, PE  
Mr. Rashid Mahmood, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Extensive deposits of low to medium grade iron ore are available in district Tharparker, Sindh province, Pakistan. These deposits contain mainly hematite mineral along with minor amount of magnetite and siderite. Preliminary studies show that ore is fine grained in nature. The average iron content is 40 pct. The main impurities are silica and alumina. The ore will be used as raw material for production of metallurgical grade iron concentrate. The iron concentrate would be used in blast furnace / direct reduction process.

**Objective:**

- The main objective is to develop a suitable process for the upgradation of indigenous low to medium grade iron ore to produce a commercial grade iron concentrate for industrial utilization.

**Present Status:** On-going

**Targets for 2019-20:**

- Evaluation studies.
- Beneficiation studies.
- Optimization of process parameters.
- Evaluation of end product and report writing.

**Title:** Development of Fulvic Acid from Indigenous Coal

**Project Leader:** Mr. Zahid Mahmood, SSO

**Project Associate:** Ms. Asma Sheikh, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Fulvic acid is a long chain complex natural compound which is a major component of earth soil rock sediments and water bodies. It is found in nature as a product of microbial metabolism and can be extracted by different procedures from humus substances. Particularly fulvic acid is useful as soil amendments and is more bioavailable than humic acid. Fulvic acid is also considered as a nutrient booster, that helps in absorption of microbiota, antioxidants minerals and slow down the aging. It also helps in improving digestive health and protects brain functions.

**Objective:**

- Cost effective process development for extraction of fulvic acid from local coal.

**Present Status:** On-going

**Targets for 2019-20:**

- Process development for the extraction of fulvic acid.
- Separation of fulvic acid.
- Purification and removal of heavy metals from fulvic acid.
- Optimization of process parameters.
- Characterization of fulvic acid.
- Utility testing / quality control of fulvic acid.
- Report writing.

**Title:** **Designing and Development of High Temperature Sintering Tube Furnace -1400°C.**

**Project Leader:** Mr. Pir Bukhsh khan, SSO

**Project Associates:** Mr. Muhammad Saleem, SEO      Mr. Abrar Ahmad, JE  
Mr. Muhammad Yousaf, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Powder metallurgy processes use sintering to convert metal powders and other unique materials into end-use parts. Sintering typically takes place in a single, elongated furnace with different temperature zones. To facilitate the process, alloying elements or pressing lubricants may be added to the metal powder. Metal powders such as titanium, cobalt chromium and stainless steel are often produced using plasma atomization. In traditional solid state sintering, pressing lubricants are first eliminated *via* evaporation and/or combustion of the vapours. Oxides on particle surfaces must also be sufficiently reduced to allow the process to work. The iron powders used in traditional powder metallurgy are often manufactured using high-pressure water atomization, a relatively inexpensive method used with metals that do not react with water. This method produces irregularly shaped particles.

**Objective:**

- To develop a need base product to fulfill the demand of R&D Labs. / Institutes of the

country. The instrument will prove to be good and low cost import substitute.

**Present Status:** New Project

**Target for 2019-20:**

- High Temperature Sintering upto 1400°C will be designed and fabricated.

**Title:** **Development of Magnesium Meta Silicate Composite Body for Electrical Insulators**

**Project Leader:** Mr. Akhtar Shahnaz, SO

**Project Associates:** Dr. Bakht Bahadur Ranan, PSO Ms. Phool Shahzadi, SO

**Duration:** 01 Year

**Year of Initiation:** 2019

**Background:**

Magnesium meta silicate composite material is tough, hard and dense ceramics and finds its application in ceramic industries. The demand of electrical insulators are increasing day by day. All the industries are importing the magnesium silicate based electrical insulators and there is no single unit in Pakistan, which is manufacturing such type of electrical insulator.

**Objective:**

- To develop magnesium meta silicate composite ceramic body using indigenous raw material which will save foreign exchange

**Present Status:** New Project

**Targets for 2019-20:**

- Procurement and processing of raw materials.
- Calculation of batch compositions and preparation of ceramic green body.
- Optimization of parameters and sintering of green bodies.
- Characterization of samples.



**Title:** Design and Development of Apparatus for Safety Glass Impact Test for Buildings and Structures

**Project Leader:** Engr. Ali Imran, JE

**Project Associates:** Dr. Muhammad Latif, SSO Engr. Abdullah Saqib, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Safety glass is a typical glass with additional safety features that make it less likely to break or less likely to pose a threat when broken. The evolution of building construction has led to the development of codes and standards that mandate structurally sound, energy-efficient and environmentally conscious buildings. Many of these codes and standards apply directly to glazing components and should be thoroughly investigated prior to design finalization. Besides this, the personal safety factories are much important in buildings and structures in modern era.

**Objective:**

- To develop equipment from indigenous resources as an import substitute, that can fulfill the testing facility as per set international standards and could be sold to other R&D and educational institutions instead of spending our foreign reserves to import from other countries.

**Present Status:** New Project

**Target for 2019-20:**

- To design apparatus for safety glass impact test for building and structure.

**Title:** Processing of Castor Crop for Industrial Products

**Project Leader:** Dr. Zeeshan Ali, PSO

**Project Associate:** Dr. Saima Siddique, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

The castor crop needs very low irrigation water and generally seeds are exported without value addition for development of industrial chemicals and products. Biopolymers use in textile finishing chemicals, cosmetics, paints, coatings, inks, lubricants, bio-diesel and different varieties of industrial chemicals and products.

**Objectives:**

- Utilization of indigenous crop of semi arid regions, which need low irrigation water.
- Development of chemicals and products for import substitution.
- Higher export potential through technology and value addition.

**Present Status:**

- Comparative study of different variety of seeds of Balochistan, Sindh and Punjab.

**Targets for 2019-20:**

- Evaluation of raw materials i.e. crops from different regions of Pakistan.
- Chemical conversions and technology.
- Industrial chemicals and products development.
- Pilot plant production prefeasibility studies.
- Industrial evaluations and commercialization of technology.

**Title:** **Development of Tanning Aldehyde (TA) Based Gel and their Applications on Industrial Effluents.**

**Project Leader:** Ms. Asma Inayat, SSO

**Project Associates:** Mr. Shahid Rehman Khan, SO  
Mr. Arshad Ali, JTO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Tannin aldehyde (TA) based on hydro-gels, have applications in various fields. Tannins have been extracted from different parts of the plants using solvent-water system. The extracted tannin has been used for the preparation of TA gels which have applications in various fields. Tannin aldehyde gels prepared in this study will be utilized for the removal of heavy metals from industrial effluents.

**Objectives:**

- Utilization of waste part of plants for the preparation of useful hydrogels.
- Removal of toxic heavy metals from industrial effluents.
- Eco-friendly environment.

**Present Status:**

- Tannin have been extracted from ten different plant resources.
- Process of extraction has been optimized.

**Targets for 2019-20:**

- Development of tannin hydrogels using different tannin and aldehydes.
- Application of developed gels on industrial effluents for the removal of heavy metals.

**Title:** **Development of Tanning Agents from Natural Sources and their Application on Leather**

**Project Leader:** Mr. Shahid Rehman Khan, SO

**Project Associates:** Ms. Asma Inayat, SSO      Mr. Arshad Ali, JTO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Tannins are poly-phenolic compounds and can be extracted from plants using water as solvent. Different researchers have worked on the extraction of tannins from different parts of the plants using solvent-water system. These poly-phenolic extracts can be used in tanning and re-tanning process during leather manufacturing. Tannins extracted will be used in the tanning/re-tanning process in leather manufacturing.

**Objectives:**

- Identification/selection of plants having significant concentration of useful tannin.
- Preparation of vegetable tanning agent from waste part of the plants.
- Saving of foreign exchange consumed in the import of vegetable tanning agents like mimosa, quebracho etc. from abroad.

**Present Status:**

- Tannin have been extracted from ten different plant resources.
- Process of extraction has been optimized.

**Target for 2019-20:**

- Application of extracted tannin in leather re-tanning.

**Title:** Extraction, Evaluation and Applications of Natural Bark Dye on Jute Fabric with the Use of Biomordants

**Project Leader:** Ms. Azra Yaqab, SO

**Project Associate:** Dr. Zafar Iqbal, SSO Ms. Lubna Liaqat, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

As prohibited amine based dyes like Benzedine are banned throughout the world. So, now a days synthetic dyes have become a great challenge for the world because cleavage of synthetic azo dyes produce amines that are carcinogenic and allergenic. Due to pollution problems in our environment, safety and sustainability of dyes is more important. So, there is an extended need of non hazardous and environment friendly colourants in different industries including textile, leather, food, pharmaceutical, paper and plastic industry. Environmental and ecological directions are turning out to be stricter everywhere throughout the world and compelling the movement of innovation towards less contaminating or especially non-polluting technological improvements and developments. So, promotion and utilization of natural dyes deserves encouragement. Natural dyes include colourants that are derived from different parts of plants i.e. barks, roots, stems and berries, animals, minerals and vegetables. Keeping in view the above scenario the present research work with natural plant bark's dye is taken into consideration.

**Objective:**

- Extraction, evaluation and applications of natural bark dye on jute fabric with the use of bio-mordants.

**Present Status:**

- Dyes from the *Acacia nilotica* (acacia bark) and *Eucalyptus glabrous* (Eucalyptus bark) are extracted and applied on jute fabric.

**Targets for 2019-20:**

- Extraction of dye from *Acacia nilotica* and *Eucalyptus glabrous* bark and applied on jute fabric.

- Purification of dyes by different solvents IR and Lambda max of purified dyes.
- Colour fastness properties of dyed fabric.
- To determine the colour measurement properties.
- Extraction of dye from walnut (*Juglan regia*) and pomegranate (*Punica granatum*) barks and applied on jute fabrics alongwith evaluation of colour fastness and colour measurement properties.

**Title:** Development of Spin Finish for Textiles

**Project Leader:** Ms. Filza Zafar Khan, SSO

**Project Associate:** Mr. Syed Faheem Shah, JSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

For the spinning of fibers other than cotton such as wool, chemical fibers and synthetic fibers, a lubricant of some sort is generally used in order to improve their characteristics. For cotton spinning, by contrast lubricants are usually not used because cotton by nature is basically suited for spinning in terms, of cotton wax, fiber shapes, fiber lengths, fineness and fiber hygroscopicity. With the increase in the speed and size of the spinning machines in recent years, however, characteristics of synthetic fibers regarding spinning have significantly improved. For cotton spinning too, it is coming to be considered insufficient to depend merely on the natural characteristics of cotton and it is desirable for further improving spinning characteristics by applying an appropriate treatment agent prior to the spinning. A particular problem in cotton spinning is tendency to become wrapped around rollers. Although this tendency is greatly influenced by many characteristics of raw cotton and it is particularly a problem with raw cotton with a large quantity of honeydew. As means for improving the processability of raw cotton, washing and corona discharge methods have been reported but they cannot sufficiently prevent raw cotton from becoming wrapped around the rollers and there is yet to be discovered an effective method against this problem. The methods which are currently being used in cotton spinning factories hardly go beyond reducing the temperature and humidity of the environment, or in the case of raw cotton with a large quantity of honeydew. It is mixing with raw cotton and little honeydew and spinning them together. The recent requirements to significantly improve the

spinning characteristics of cotton cannot be satisfied by such processes. The cost of energy in the operation increases inevitably if temperature and humidity will reduced.

**Objective:**

- Development of a spin finish for natural and synthetic fibers from indigenously available resources. There is a potential for development of feasible processes to be sold to the local industry subject to customer demand.

**Present Status:**

- Literature survey has been performed.
- Procurement of raw materials is being done.
- Laboratory scale trials are in progress.

**Target for 2019-20:**

- Laboratory scale development of spin finish.

**Title:** **Conversion of Solid Waste into Environmentally Friendly Slow Release Nano-Fertilizer**

**Project Leader:** Dr. Rabia Nazir, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Food availability is the major issue faced by both developing and developed nations. The current world population is multiplying at enormous rate which is making availability of food a growing concern. As a result of this food growers are under enormous pressure to enhance food productivity without sacrificing its quality. The use of excessive amount fertilizers not only deteriorates food quality but also causes many environmental problems like water pollution, poor soil quality etc. The use of nano-fertilizers can help in improving the crops yield and better nutritional values of the crops. These nano-fertilizers can offer better yield, improve plant growth, better soil condition with very small application rates. Another main issue faced globally is effective utilization of solid waste produced by different processes. Hence, the project focuses on synthesis of charcoal-based nano-fertilizers that will help in increasing the soil productivity

and promoting availability of nutrients to the plants by avoiding leaching into ground waters. The basic purpose of the project is to help in enhancement of food productivity, while addressing the pollution issues that is created by excessive use of conventional fertilizers and consequently leaching of nutrients like nitrates and phosphates into ground water reservoirs and release into air as gases. The research will provide a four way advantage over the current practices

- Solid waste management.
- Slow release of nutrients there by avoiding losses due to leaching.
- Environmental friendly approach in sense that fertilizer itself will be synthesized using simple approach and also by controlling leaching of nitrates and phosphates it will prevent the damage or otherwise caused to fresh and ground water reservoirs.
- Reserving the foreign exchange spent on imports of fertilizers and related chemicals.

**Objectives:**

- Utilization of solid waste for synthesis of nano-fertilizer.
- Effect of prepared biochar-based nano-fertilizer on the selected plants' germination and growth.
- Efficacy of prepared biochar-based nano-fertilizer in comparison to conventional fertilizers.

**Present Status:**

- Lab scale studies for preparation of bio-char based nano-fertilizer is in progress.

**Target for 2019-20:**

- Development of bio-char based nano-fertilizer and evaluation of its effectiveness as compared to conventional fertilizer.



**Title:** **Production of Different Types of Cheese from Buffalo and Cow Milk**

**Project Leader:** Dr. Asma Saeed, PSO

**Project Associates:** Dr. Quratulain Syed, CSO Dr. Sania Mazhar, SSO  
Mrs. Shabana Kauser, SO

**Years of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Cheese is an important dairy product formed by coagulation of the milk protein casein. Cheese is considered an essential food item on the basis of its longer shelf life in addition to high fat, protein and minerals contents. Mozzarella and Cheddar cheese are most popular because of their use in bakery products, soups, sauces and ready to cooked dishes. An assessment of Pakistan's cheese production revealed that the annual demand of cheese in Pakistan is 5,000 tones whereas, local production remains at around 3049 tones. On the notice and assigned job of Federal Minister of Science and Technology to PCSIR Labs. Complex Lahore, the process and technology of different types of cheese production while using buffalo and cow milk are being developed. In this regard, a continuous collaboration with M/s Malmo Foods (Pvt.) Ltd., Lahore is in progress as well for technology share and commercialization.

**Objectives:**

- Utilization of buffalo and cow milk in the form of loose, full cream and packed milk for production of cheese.
- Process development of Mozzarella and Cheddar cheese for providing import substitution.
- Production of technically and economically feasible cheese products.
- Facilitate the potential food entrepreneurs for Human Resources Development (HRD) along with self-reliance of local food industries and economic growth of country.

**Present Status:** On-going

**Targets for 2019-20:**

- Process develop for Mozzarella and Cheddar cheese.
- Technology transfer in the form of process development and technical report.

**Title:** Development of Low Cost Efficient Method Based on Capacitive Deionization for Removal of Heavy Metals (Arsenic) from Drinking Water

**Project Leader:** Engr. Jehanzaib Anwar, JE

**Project Associates:** Dr. Asma Saeed, PSO Mrs. Shabana Kausar, SO  
Engr. Muhammad Azam, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

With climate change, the scarcity of clean drinking water resources has become one of the most important issue worldwide. To overcome shortages of clean water, groundwater is commonly used. But, the high arsenic content in groundwater is observed in many areas of Pakistan, which can cause significant health hazard. Long term exposure to arsenic by the human body leads to various harmful health effects, particularly skin diseases and cancers. Therefore, a maximum allowable limit of 10 parts per billion (ppb) was recommended by the World Health Organization (W.H.O.). To remove arsenic from groundwater, several technologies have been used, including precipitation, coagulation, electro-coagulation, reverse osmosis, electro-dialysis, and adsorption. However, these technologies has been proven expensive, require replacement or maintenance of filters, produces secondary waste etc. Noteworthy, electric driven techniques such as electro-dialysis (ED) and capacitive de-ionization (CDI) can effectively separate ions or charged species from aqueous solutions, especially for the removal of low level dissolved ions. This technique also has many advantages such as relatively low costs, low maintenance, minimal fouling and can be cleaned using reverse methodology. Therefore, CDI technology has been used for desalination, hard water softening, heavy metal removal, and groundwater remediation.

**Objectives:**

- Fabrication of porous electrodes.
- Tailoring their properties for the enhancement of capacitance.
- Efficiency analysis of electrodes for the removal of heavy metals i.e. arsenic.

**Present Status:**

- Literature review has been completed.
- Experimentation has been started and the results of our initial experimentations are very encouraging.

**Targets for 2019-20:**

- Fabrication of electrodes which efficiently remove heavy metals from the drinking water.
- Fabrication of experimental device.

**Title:** Fortification of Different Bakery Products with Vitamin A

**Project Leader:** Dr. Asma Saeed, PSO

**Project Associates:** Ms. Shabana Kauser, SO Dr. Shahid Masood, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Malnutrition is a condition that results from eating a diet in which one or more nutrients are either not enough or are too much, such that the diet causes health problems. Not only there are high levels of malnutrition and micro-nutrient deficiency in Pakistan but there has been a lack of improvement in nutritional outcomes. Treating malnutrition through fortifying foods and particularly bakery products with micro-nutrients (vitamins and minerals) improves lives at a lower cost and shorter time. The aim of the project is to prepare a range of bakery products fortified with vitamin A as a step to overcome malnutrition at indigenous level. Fortification of bakery items with vitamin is attractive, technically feasible, and potentially effective as the nutrient stability in the products is good. The bakery products to be focused for fortification are bread (white, brown, flavoured) cakes, and cookies that are consumed in all the communities of Pakistan. The product cost is not much increased as there's often no need for changes in manufacturing process and above all these products would offer a replacement of imported fortified products.

**Objectives:**

- To prepare a range of bakery products (breads, cakes & cookies) fortified with vitamin A.
- To study the shelf life of prepared fortified products.
- To develop a cost- effective, technically feasible and efficient technology.
- To overcome vitamin A malnutrition at indigenous level.
- To replace the imported fortified products/ supplements.

**Present Status:** On-going

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**Targets for 2019-20:**

- To prepare multiple Vitamin A fortified products for children.
- Organoleptic acceptability of the developed products.
- Shelf-life studies of the developed products.
- Nutritional analysis of the developed products.

**Title:** **Designing and Fabrication of Equipment for the Quantitative Estimation of Arsenic in Water**

**Project Leader:** Engr. Muhammad Azam, JE

**Project Associates:** Dr. Asma Saeed, PSO      Ms. Shabana Kausar, SO  
Engr. Jehanziab Anwar, J.E

**Year of Initiation:** 2018

**Duration:** 01 Year

**Background:**

Arsenic is known to be highly toxic to all life forms. This element has been classified by the World Health Organization as a group 1 human carcinogenic substance. Intake of inorganic arsenic at high concentrations present in drinking water causes different kinds of skin lesions and cancers. Based on World Health Organization (WHO) guidelines, arsenic concentrations in drinking water should be strictly limited to 10µg/L. The arsenic contamination has seriously affected public health in Pakistan, especially in highly contaminated Sindh and Punjab provinces. Expensive equipment such as ICP-OES, ICP-MS, GFAAS, Flame AAS etc. are used for the quantitative determination of arsenic in contaminated water. These costly techniques need regular maintenance, repair, outdated software from time to time and highly skilled manpower to operate. Keeping in view of the above mentioned drawbacks, the current project will investigate to develop cost effective, easy to operate, an import substitute, environmental friendly equipment for the quantitative determination of arsenic in drinking water.

**Objectives:**

- To design and fabricate cost effective equipment for quantitative determination of arsenic as low as 1.0 ppb level.
- To develop environment friendly and easy to operate system for the quantitative estimation of arsenic in water and food products.

**Present Status:** On-going

**Targets for 2019-20:**

- Software designing and material selection.
- Fabrication of multiple assemblies.
- Designing and experimental operation.
- Quantitative estimation of arsenic.

**Title:** **Development of Paper Based Analytical Devices for Detection of Milk Adulteration**

**Project Leader:** Dr. Salman Saeed, SSO

**Project Associates:** Dr. Khurram Shahzad, SSO Dr. Abdul Ahid Rashid, SSO  
Ms. Shaista Nawaz, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Adulteration, economically motivated fraud, unhygienic and unsafe handling and processing of milk are the major issues associated with dairy industry in Pakistan. Traditional wet chemistry methods for nutritional quality assurance and milk safety assessment are laborious, time consuming and require the use of hazardous chemical consumables in large quantities. Particularly methods for screening out the adulteration are not standardised and recommended by any internationally reliable institute or body. Besides, it is always difficult to handle large number of samples in the shortest available time. Present project aims to develop paper based analytical dipsticks which can rapidly and non-destructively assess the quality of milk cost effectively for selected parameters.

**Objective:**

- Development of paper based testing devices for detection of various hazardous chemicals and adulterants in milk.

**Present Status:**

- Chemical methods for the screening detergent, formalin and neutralizer chemicals have been standardised and validated.

**Target for 2019-20:**

- Development of paper based testing devices for detection of various hazardous chemicals and adulterants in milk.

**Title:** **Physicochemical Properties of Broken Rice and its Utilization in Development of Value Added Product**

**Project Leader:** Ms. Shumail Usman, SSO

**Project Associates:** Dr. Ijaz Ahmad, PSO          Ms. Saima Nazir, SSO  
Ms. Ammara Yasmeen, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Rice is a major food commodity throughout the world. The main by-products of rice milling are rice hulls or husk, rice bran and brewer's rice. Nutritionally, broken rice is as good as whole rice itself. Broken rice has low economic value as compared to whole rice. Generally, broken rice is of poor quality due to admixture with grit, stones and clay particles. Therefore, broken rice is used either as a part of animal feed or partially in the diet of poor people. If the quality of broken rice is improved by cleaning the paddy properly before milling, it can be utilized and marketed straightway for preparation of variety of snack foods and other such preparation in which rice flour or wet-ground rice paste is needed.

**Objectives:**

- To study the physico-chemical characteristics of broken rice based composite flours.
- Utilization of broken rice flour to develop value added product.
- Sensory and nutritional evaluation of developed product.

**Present Status:** On-going

**Targets for 2019-20:**

- More nutritionally enriched products will be developed by using under utilized broken rice
- Organoleptic and nutritional composition will be improved.

**Project:** Development of Cellular Metallic Materials (CMM)

**Project Leader:** Engr. Muhammad Nouman, J.E

**Project Associate:** Engr. Ahmed Raza, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Cellular Metallic Materials (CMM) are multifunctional materials. They have highly porous structure and flexible in geometry. The increasing interest in cellular metals is due to the fact that the introduction of pores into the materials significantly lowers the density. These highly porous materials also possess combination of properties which are not possible to achieve with other metallic materials. Besides the drastic weight and material savings that arises from the cell structure, there are also other application specific benefits such as noise and energy absorption, heat insulation, mechanical damping, filtration effects and also catalytic properties. CMM are hence multifunctional light weight materials.

**Objectives:**

- To produce the cellular metallic material locally using aluminum powder through powder metallurgical route.
- To reduce the energy and cost value in the production of Cellular Metallic Materials (CMM).
- To develop cellular structure by using replica sponge and powder pressing method.

**Present Status:**

- Raw materials have been selected and its sources have been identified.
- Trial experiments are planned after literature review.

**Target for 2019-20:**

- To develop CMM and to study its suitability in different applications such as mechanical damping, heat insulation etc.

**Title:** Treatment of Industrial Dye Production Effluent at Lab Scale

**Project Leader:** Dr. Farah Deeba, SSO

**Project Associates:** Dr. Muhammad Tahir Butt, PSO  
Dr. Naeem Abbas, SSO

**Year of Initiation:** 2018

**Duration:** 1.5 Years

**Background:**

Mankind has been using dyes for thousands of years. The big consumers of dyes are textile, dyeing, paper and pulp, food industry, tannery and paint industries. Textile and dyeing mills use large amounts of water and discharge coloured wastewater that are heavily polluted with dyes, textile auxiliaries and other chemicals. Dyes are considered an objectionable type of pollutants because they are toxic, causes skin irritation and carcinogenic. They impart colour to water which causes the destruction of aquatic communities present in ecosystem. Chemical treatment of dye wastewater with a coagulating / flocculating agent is one of the robust ways to remove colour. Generally, this process is economically feasible if uses low cost commercial chemicals that satisfactorily remove dyes. Low cost adsorbents will also be used.

**Objectives:**

- Environment friendly treatment of coloured wastewater (food, textile).
- Treatment with agricultural waste.
- Biological treatment.

**Present Status:** On-going

**Target for 2019-20:**

- Treatment of coloured waste water from food and textile industries with coagulating / flocculating agent.



**Title:** **Process Development and Production of Analytical Grade Chemicals (HCl, H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> and CH<sub>3</sub>COOH, Ammonium Hydroxide) on Laboratory Scale**

**Project Leader:** Dr. Muhammad Tahir Butt, PSO

**Project Associates:** Dr. Farah Deeba, SSO      Dr. Naeem Abbas, SSO  
Mr. Javed Iqbal, SO

**Year of Initiation:** (On-going regular activity)

**Duration:** Continuous activity as per demand of LLC.

**Background:**

All mineral acids are being imported which are used in industry, R& D organizations and testing labs of various industries such as dairy, wastewater treatment, mineral water, metal processing etc. This study is focused to develop the processes at local level to fulfill our demands to the foreign exchange. Ammonium hydroxide (NH<sub>4</sub>OH) is primarily used as a solvent in many processes of industries as well as in the manufacture of products such as plastic, rayon and rubber and to synthesize a number of chemicals, like sodium carbonate. It can be used as a fluid for refrigerators and as a neutralizer during processes that use acidic chemicals. Its high alkalinity, however, also makes it very corrosive to certain metals, including aluminum, making it useful for industries like circuit board manufacturers. NH<sub>4</sub>OH is used in puncture seal products, tire inflators, fiberglass cleaners, metal cleaners and polishes, cosmetics, explosives, hair care products, shaving cream, lotions, creams, acne treatments and as a leavening agent or acidity regulator. Its pH control abilities make it an effective antimicrobial agent. Ammonium hydroxide is also used to treat straw, producing "ammoniated straw" making it more edible for cattle.

**Objective:**

- Self-reliance, foreign exchange saving, import substitute.

**Present Status:**

- Production of different mineral acids and ammonia solution as per demand of LLC laboratories.

- Production of analytical grade hydrochloric acid and quality testing.
- Production and quality testing of sulfuric acid (98 %), hydrochloric acid (36 %), nitric acid (65 %) and acetic acid being supplied to main chemical store for testing and R&D work. To determine percentage purity of ammonia solution and to optimize and standardize testing procedure.
- Until now worth of approx. 76,20,000/- were supplied to main chemical store for analytical testing and R&D work.

**Target for 2019-20:**

- Production of acids and ammonia solution on demand from main chemical store PCSIR Labs. Complex, Lahore to safe national revenue commercialization of these products through STEDEC to local industry, R & D organizations and universities.

**Title:** **Development of Inert Material for Heavy Metal Removal from Underground Water at Micro-Pilot Plant Scale**

**Project Leader:** Dr. M. Hammad Khan, SSO

**Project Associates:** Dr. M. Tahir Butt, PSO      Dr. Farrukh Hussain, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Seepage of industrial wastewater is exacerbating the problem causing higher concentration of toxic heavy metals in underground water. The high level of toxic heavy metals like arsenic, manganese, chromium, lead and mercury cause health problems ranging from skin irritation to cancer. The use of separation treatment technologies can remove the toxic metals found in the range of ppm and ppb. An inert material has been prepared to remove the toxic heavy metals from underground water, cost effectively at lab scale by indigenous very low cost materials. Different compositions of the raw material were tested for the preparation of the inert material and varied the conditions of preparation, as well. The prepared material was tested in batch tests. It could remove arsenic upto 95% giving water with below 10ppb arsenic. Currently, testing on a larger lab scale column (1L bed volume) is being conducted. Different flow rates, hydraulic retention times and the initial concentration are being tested to optimize the adsorption efficiency

and capacity. In next step, a large batch of inert material will be prepared and used to test at micro-pilot plant scale to assess cost efficiency of the process.

**Objective:**

- Test the cost and efficiency of arsenic removal at micro-pilot plant scale.

**Present Status:** On-going

**Target for 2019-20:**

- Set up of a larger column of almost 50Kg inert material to test the arsenic removal for a higher flow rate that can be used at domestic or sub-commercial level.

**Title:** UF MF Membrane Fabrication Technology Development

**Project Leader:** Dr. M. Hammad Khan, SSO

**Project Associates:** Dr. M. Tahir Butt, PSO Dr. Farrukh Hussain, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Membrane separation is a state-of-the-art technology that has no equals in the fields where it works. With the ever increasing industrialization and drinking water demand high amounts of membranes are being imported to Pakistan. The most commonly used ones are microfiltration (particle separation), ultrafiltration (purification), nano-filtration (desalination) and reverse osmosis membranes (desalination). So far till now, there is very limited know-how about the fabrication of the membranes in Pakistan industrial sector. It can be achieved in phases. Currently, our objective is to develop technology for simple membranes (for aqueous phase separations). Later, improved membranes will be developed by modified fabrication methods and materials to achieve better efficiency. This project is focused at simple membrane fabrication. Currently, we prepared the membrane from locally available polymeric materials but the prepared membrane lacked consistency in production and uniformity in the surface morphology. Therefore, it is planned to change the polymeric raw materials to more environment friendly. At the same time a PSF concept paper has already been approved.

**Objectives:**

- Development of technology to fabricate the organic polymer membranes i.e., MF, UF.
- Test the material and fabrication for improved efficiency and selectivity.

**Present Status:** On-going

**Targets for 2019-20:**

- Test the new planned raw material for membrane fabrication in the current setup.
- Meanwhile, apply for the PSF full length project for funding to purchase proper equipment.

**Title:** Extraction of Gold from Hunza River Sand

**Project Leader:** Engr Adnan Akram, CE

**Project Associate:** Dr. Irfan Hafeez, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

In northern areas of Pakistan gold found in small nuggets/particles in sand located along the bank of rivers. The local residents of these areas are extracting gold from river sand using old techniques such as panning and amalgamation process. There is an urgent need to develop a cost effective technology for the extraction of gold from this resource. The successful development of technology would help to produce gold indigenously at low cost instead of importing gold.

**Objectives:**

- To utilize the sand of Hunza river for gold production.
- To develop an economically feasible process for gold separation from sand.
- To get metallic gold from this sand.

**Present Status:** On-going

**Targets for 2019-20:**

- Chemical evaluation of the samples of procured sand.

- Beneficiation of sand using suitable techniques and preparation of concentrate.
- Panning trials.
- Weight recovery and product evaluation will be estimated.
- Results will be compiled and technical report produced on the basis of bench scale results.

**Title:** Up-gradation of Indigenous Minerals (Bauxite) for Metallurgical and Non-Metallurgical Applications by Innovative Beneficiation Techniques for Local Industry

**Project Leader:** Ms. Uzma Zafar, SSO

**Project Associates:** Mr. M. Arif Bhatti, SSO Mr. Ansar Mehmood, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

The industry requires specific quality bauxite for both non-metallurgical and metallurgical applications. R&D programme has been taken up to up-grade bauxite for its possible utilization. Growth in the markets for raw bauxite is expected to be 3 – 4 % a year and its demand has continued to increase. A set of applications have been developed, these include Alumina based chemicals refractioneries, abrasines, and calcined alumina to produce alumina concentrates etc.

**Objective:**

- Development of high-grade bauxite for local industry.

**Present Status:** On-going

**Target for 2019-20:**

- Flotation studies of aluminum ores (bauxite) for its economical beneficiation and upgradation for the extraction of alumina.

**Title:** Nano-Materials Based Coatings for Multifunctional Impacts on Glass Substrate

**Project Leader:** Ms. Phool Shahzadi, SO

**Project Associates:** Dr. Bakhat Bahadur Rana, PSO  
Mr. Akhtar Shahnaz, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Coatings deliver an invisible/ visible and durable surface that provides water repellent, residue resistant, photochromic, thermochromic and antibacterial properties. Nano-coatings can be formulated for a long lasting, durable and environment friendly coatings for a wide variety of substrates. The non-stick coatings enable smooth glass-like surfaces to have less contact with dirt particles. The hydro effects cause particles of contamination to adhere less to the substrates and allow them to be easily removed from the water repellent coating, i.e. without applying any cleaning procedure. Self cleaning surface for instance Lotus leaf depends on multi-scale architectural and consistent re-occurring possessions of organic matter. The self-cleaning coatings express exceptional anti-abrasion confrontation sustaining super-hydrophobicity. The present work will mainly focus on antibacterial and water repellent coating causing cleaning effect on substrate. Coating will be developed for their use on sheet glass (commonly used for windows, glass doors, transparent walls, windscreens and for modern architecture). Method of coating will be simple dip coating and spray coating on substrate. The finally developed products will be coated on glass substrate to investigate the self cleaning properties. These coatings will be characterized by using various characterization techniques like, FTIR, SEM and contact-angle for further refinement and improvement of the properties of the product.

**Objectives:**

- To develop nano-material based coatings on glass substrate for various applications like, strong hydrophobicity, hydrophilicity, excellent self clean performance on contamination, antimicrobial.
- Invisible to the human eye (coating thickness: 100-150 nm).
- Permanent (UV-stable, enormous abrasion-resistance).

- Transparency.

**Present Status:** On-going

**Targets for 2019-20:**

- Procurement of required materials, accessories and consumable, etc (electric oven glass assembly etc).
- Application of coating material on subtract characterization of coated samples.

**Title:** **Design and Development of Dumbbell Cutting Machine**

**Project Leader:** Engr. Ali Imran, JE

**Project Associates:** Mr. Muhammad Azhar, SSO  
Engr. Junaid Israr, JE  
Engr. Noor Faraz, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

With the day by day increasing requirement of rubbers / insulating material / plastic materials in construction, the need for testing is also growing at an increasing rate to analyze and examine the properties of different types of materials. For stable and accurate test results, it is also important to use the specimen of standard shape and size. The quality of these materials shows a significant effect on the quality of the end products which directly affect the safety of the products. Tests / quality assurance of the products can be performed by accurately using high testing strategies that are provided by the reputed standardization authorities like ASTM, ISO, BIS and many more that offers stable and precise test results. Dumbbell cutting is the widely used test machine that contributes to prepare the samples of standard size for the testing procedure.

**Objectives:**

- By the design and development of Dumbbell Cutting Machine, indigenous design, import substitute, R&D support, time & energy, saving can be achieved.

**Present Status:** On-going

**Targets for 2019-20:**

- Commercialization of the product / revenue generation
- Industrial support
- In-house R&D support

**Title:** **Design and Development of Apparatus for Safety Glass Impact Test for Buildings and Structures**

**Project Leader:** Engr. Ali Imran, JE

**Project Associates:** Dr. Muhammad Latif, SSO Engr. Abdullah Saqib, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Safety glass is a typical glass with additional safety features that make it less likely to break or less likely to pose a threat when broken. The evolution of building construction has led to the development of codes and standards that mandate structurally sound, energy efficient and environmentally conscious buildings. Many of these codes and standards apply directly to glazing components and should be thoroughly investigated prior to design finalization. Besides this, the personal safety factories are much important in buildings and structures in modern era.

**Objective:**

- To develop laboratory test equipment from indigenous resources as an import substitute.

**Present Status:**

- Equipment handed over to Glass and Ceramics department for real time execution and feed back.

**Target for 2019-20:**

- To develop apparatus for safety glass impact test.



**Title:** Development of Roller for Thread Cone Winding Machine

**Project Leader:** Engr. Ali Imran, JE

**Project Associates:** Engr. Noor Faraz, JE                      Engr. Abdullah Saqib, JE

**Year of Initiation:** 2019

**Duration:** 06 Months

**Background:**

Textile is the 2<sup>nd</sup> biggest revenue generation sector in our country and most of its production machinery and maintenance parts are imported. Many of the machine parts being used require excessive repair and replacement.

**Objective:**

- To develop roller for Thread Cone Winding Machine as an import substitute item.

**Present Status:**

- Design and development completed.
- Execution for final product.
- Actual dimensions of various parts involved have been measured.
- Metal cylinder section has also been cut to required size.
- Brass made parts have been cut but material failure observed during internal threading.
- Material failure study is in progress and different causes and further options are being considered.

**Targets for 2019-20:**

- Once the brass section will be made available as required, parts assembling will be done.
- Product finishing will be done along with testing.

**Title:** Silver and Clay Nanoparticles Based Composite Coating Formulations for Shelf-Life Extension of Fruits and Vegetables

**Project Leader:** Dr. Quratulain Syed, CSO

**Project Associates:** Dr. Sania Mazhar, SSO      Engr. Abad Ali Nadeem, JE

**Years of Initiation:** 2019

**Duration:** 1.5 Years

**Background:**

Pakistan is one of the largest producers of fresh fruits and vegetables for both home markets and exports, owing to its wide range of favourable agro-climate. The fruits and vegetables market in Pakistan is valued at USD 8.0 billion in 2017 and is expected to register a CAGR (compound annual growth rate) of 5.6% in near future, hereby allowing Pakistan to retain its position in the global trade of fruits and vegetables. However, high decay rates is posing a significant challenge to the storage of fruits and vegetables leading to loss of nutrients, change in their flavor, colour and texture in addition to the spread of micro-organisms. Therefore, innovative technologies such as edible coatings and packaging films embedded with silver and clay nanoparticles are possible solutions for maintaining the natural quality of agricultural products during storage and shelf time.

**Objectives:**

- Development of technically and economically low cost and environment friendly packaging film/bags coating formulation with a relatively simple processibility.
- Prevention of the quality loss in post harvest fruits and vegetables.
- Prolongation of shelf life and enhancement of storage quality.
- Reduction in storage costs due to better utilization of space with developed packaging films/bags.
- Human Resources Development (HRD) along with self-reliance of agro-industries and economic growth of country.

**Present Status:** New Project

**Targets for 2019-20:**

- Development of silver and clay nano-particles based coating formulations.

- Microbiological analysis of developed nanoparticles.
- Incorporation of developed nanoparticles on polyethylene films/bags.
- Analysis of cumulative percentage physiological loss in weight (PLW) of fruits and vegetables during storage at 27±2°C and 65% RH (relative humidity).
- Evaluation of fruits and vegetables firmness during storage at 27±2°C and 65% RH.
- Assessment of sensory attributes like colour, flavour and taste during storage at 27±2°C and 65% RH.

**Title:** **Development of Biosynthetic–Nanoparticles (NPs) and Efficacy Studies Against the Water-Borne Pathogens**

**Project Leader:** Dr. Quratulain Syed, CSO

**Project Associate:** Dr. Ammara Hassan, SSO

**Years of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Approximately, one-sixth of the world's population suffers from access to clean drinking water. Nowadays, climate change, overpopulation, limited water resources, pollution and lack of water sustainability are considered as the most common difficulties facing human needs. Therefore, there is an urgent need to develop an innovative technology to provide clean and affordable water to meet human needs. Amongst the water contaminants, the microbial contamination in drinking water has posed serious threats to ecosystem including animals, human and plants. Nanotechnology is fast, advancing and currently has become more effective technology in purification and water treatment than the conventional technologies. Undoubtedly, the synthesis of NPs using the microbial sources offers more safe opportunities. This project is aimed to develop the microbiologically synthesized nanoparticles (Bio-NPs) using microbial strains. The aqueous solution of bio-NPs will be evaluated for the treatment and purification of water to make the water safe and free of pathogens.

**Objectives:**

- To develop the biosynthetic-nanoparticles from selected microbial strains.
- To remove the pathogens from contaminated drinking water.

- To ensure the availability of pure and clean drinking water.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Isolation of microbial strains.
- Identification and characterization of isolated microbial strains.
- Biosynthesis of nanoparticles.
- Efficacy studies of biosynthetic nanoparticles (NPs) against pathogens.
- Treatment of contaminated water using the biosynthetic nanoparticles (NPs).

## **PCSIR Laboratories Complex Peshawar**

**Title:** Isolation of Anti-Tumor Agent and its Complexation with Metals

**Project Leader:** Dr. Mushtaq Ahmad, SSO

**Project Associates:** Dr. Humaira Inayat, SSO      Dr. Muhammad Qaisar, PSO  
Dr. Hina Fazal, SSO

**Year of Initiation:** 2018

**Duration:** 01 Year

### **Background:**

Vinblastine is an indole alkaloid isolated from *Vinca rosea*. It is a potent anti-tumor agent. It is available in the market as sulphate salt mostly in injection form in a dose level of 1 and 10mg/ml with different brand names like vinblas, velbastine, blastivin, cytoblastin, lemblastine, oncostin, velban, velbastin, velbe and vinblastin. Metals are quite important for maintaining normal activities of the body and treating disorders. They are very selectively shifted to their corresponding sites of action during metabolism where they play their role. Based on the diversified role of metals and metal complexes, they are thought to be the way for the development of future metallo-pharmaceuticals.

### **Objective:**

- To selectively extract vinblastine from *Vinca rosea* plant and then treat it with different metals for complexation in the hope to not only enhance the anti-tumor activity of vinblastine but also to reduce its toxicity.

**Present Status:** On-going

### **Targets for 2019-20:**

- Extraction and concentration.
- Acid-base treatment of the concentrated extract.
- Isolation and characterization of vinblastine.

- Complexation of the target compound.
- Screening of the products for anti-tumor activities.
- Compilation of data in the form of patents/ technical report/ research articles.

**Title:** **Synthesis of Pyrazine-Based Products as Monotherapeutic Agents for Tuberculosis.**

**Project Leader:** Dr. Mushtaq Ahmad, SSO

**Project Associates:** Dr. Humaira Inayat, SSO Mr. Muhammad Siddique, SSO

**Year of Initiation:** 2017

**Duration:** 02 Years

**Background:**

Tuberculosis (TB) is mainly an infection of the lungs caused by a bacterium known as *Tubercle bacillus* or *Mycobacterium tuberculosis*. According to World Health Organization's (WHO) Global Tuberculosis Control 2009, Pakistan stands eight on the list of high-burden tuberculosis countries. In addition to multidrug-resistant (MDR), TB and TB-HIV co-infection is also growing in the country. A standard treatment for tuberculosis is isoniazid, rifampicin, pyrazinamide and ethambutol for two months, then followed isoniazid and rifampicin alone for another four months, while the standard treatment for latent tuberculosis alone with isoniazid is from six to nine months. All these treatments are based on the combination therapy.

**Objectives:**

- To synthesize differently substituted pyrazine based hydrazones, triazoles, thiadiazole, amides and diamides.
- To determine antimicrobial activities including anti-mycobacterial activities.

**Present Status:**

- Some of the targeted series of different classes of compounds have been synthesized while the rest are under process. The anti-tubercular activities of the synthesized compounds and those which are under process will be performed at Provincial Tuberculosis Reference Lab, HMC, Hayatabad, KPK.

**Targets for 2019-20:**

- Synthesis of the remaining series of compounds and their characterization.
- Performing anti-tubercular activities of the synthesized compounds.
- Compilation of research data in the form of papers, technical reports and patents.

**Title:** Development of Calendula Cream for Burning/Wound Healing

**Project Leader:** Ms. Farina Kanwal, PSO

**Project Associates:** Mr. Muhammad Siddique, SSO  
Ms Fouzia Noreen, SSO Dr. Hina Fazal, SSO  
Dr. Farah Gul, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

*Calendula officinalis* Linn. is used medicinally in Europe, China, US and Asia. It belongs to the family, Asteraceae, and is commonly known as Zergul (Hindi), African marigold, calendula, common marigold. The plant is native to central and southern Europe, Western Asia and the US. In folklore, the florets are used in ointments for treating wounds, herpes, ulcers, frostbite, skin damage, scars and blood purification. The leaves in infusion are used for treating varicose veins. Chemical studies have shown the presence of various classes of compounds, the main being triterpenoids, flavonoids, coumarines, quinones, volatile oil, carotenoids and amino acids. The extract of this plant as well as pure compounds isolated from it possess multiple pharmacological activities such as anti-HIV, cytotoxic, anti inflammatory, hepatoprotective, spasmolytic and spasmogenic. Despite the potential application of *Calendula* in conventional wound management, there has been no systematic review of the recent literature to evaluate the clinical effectiveness. This study will address vulnerary properties of calendula, because it inhibits the breakdown of skin (tissue degeneration) so, it is very effective in treating conditions such as Eczema, Psoriasis and Rosacea. The extract has been proven to cure fungal disorders, and because it stimulates the metabolism of glycoproteins, nucleoproteins, and collagen during the healing process, it is a powerful skin regeneration ingredient. On the basis of all these facts an attempt will be made to develop herbal process/product for wound healing which are caused by burning, this product will also be very effective for treating radiation dermatitis.

**Objectives:**

- Development of an effective herbal product for skin.
- Utilization of indigenous plants for preparation of herbal product.
- Quality control profile and stability studies of finished product.
- Documentation of work in the form of papers/patent/reports.

**Present Status:** On-going

**Targets for 2019-20:**

- Collection, drying and grinding of plant material.
- Extraction and concentration of plant material in suitable solvents.
- Phytochemical screening.
- Biological and pharmacological activities.
- Standardization of active constituents through standard official procedures.
- Formulation of product.
- Pharmacological activities of product formulated.

**Title:** Development of Wound Healing Product from *Berberis* spp.

**Project Leader:** Dr. Humaira Inayat, SSO

**Project Associates:** Dr. Mushtaq Ahmad, SSO Dr. Hina Fazal, SSO  
Dr. Farah Gul, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

*Berberis* (family Berberidaceae) occurs abundantly in the Himalayan region of Pakistan, northern areas such as Gilgit Baltistan, Ghizer, Astor, Diamer and Swat. Every part of this plant has some medicinal value. Its root bark (Darhald), stem and fruits (kashmal) have wide range of applications in ayurvedic preparations like reducing obesity, curative of piles and haemorrhoids, antitumor effects, liver, uterine and vaginal disorders and for the treatment of dysentery cough, diabetes mellitus etc. Because of its antibacterial and anti-inflammatory properties, it is used for quick healing of wounds. Berberine is the major isoquinoline alkaloid, isolated from root or root



bark of the *Berberis* species. Research on wound healing agents is one of the developing areas in modern biomedical sciences. The process of wound healing is promoted by several natural products which are composed of active principles like triterpenes, alkaloids, flavonoids and biomolecules. Recent experiments revealed that plant causes healing of wound by increasing the area of epithelialization and collagen deposition. Plant drugs are considered less toxic and free from side effects when compared to synthetic drugs.

**Objective:**

- To develop topical wound healing herbal product.

**Present Status:**

- Three different species of *Berberis* were collected, and identified as *B. lyceum*, *B. aristata* and *B. kansuensis*. These were dried and extracted with ethanol. Extractive values in ethanol and total alkaloid contents of all the three were determined.

**Targets for 2019-20:**

- Process and product development.
- Documentation of results in the form of papers, patents and technical reports.

**Title:** Development of Herbal Body Care Beauty Products

**Project Leader:** Mr. Muhammad Siddique Afridi, SSO

**Project Associates:** Mrs. Farina Kanwal, PSO Dr. Farah Gul, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Back ground:**

Cosmetic industry is one of the fastest growing industries. This requires the development of new products, technologies and production methods. There is increasing demand of herbal beauty products owing to the rising consumer awareness regarding harmful effects of the chemical added to the beauty products. The growing demand for natural products worldwide has impacted the Pakistani market as well. Medicinal plants growing in our country can be a cheap, indigenous and easily available raw material source for the development and preparation of

herbal body care beauty products. The high demand for this type of products in the local and international market made us turn back to nature and to the environmentally friendly production methods. Pakistan can earn billion dollars of foreign exchange by export of medicinal plants extractives and their herbal cosmetic products.

**Objectives:**

- Value addition of indigenous medicinal plants, (raw material) for the preparation of herbal body care beauty products.
- To promote local herbal cosmetics industries.
- To develop and prepare herbal cosmetics as an alternative of synthetic cosmetics products.
- To encourage the use of ecofriendly and more safe herbal cosmetics products.
- To prepare international standard herbal body care products.

**Present Status:**

- Different products have been developed under the projects such as: herbal beauty soap, herbal cream and lotion for skin protection and antidandruff herbal shampoo, antidandruff herbal hair oil, anti-hair fall herbal oil, skin protection and nourishment herbal oil for solving the hair problems.

**Targets for 2019-20:**

- Pharmacological studies (skin irritancy test).
- Volunteer's trial.
- Publications (completion report/process development/patents/papers).
- Commercialization of the developed products/process.

**Title:** Development of Process for Commercial Production of Lactulose

**Project Leader:** Dr. Yousaf Ali, SSO

**Project Associate:** Dr. Humaira Inayat, SSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Lactulose is a synthetic disaccharide normally used in the form of syrup for the treatment of intestinal disorders and in the form of crystalline product as a sweetener substituent of sucrose. It is also used as a food supplement in pediatric diets. The potential of the lactulose as a geriatric food supplement has also been recognized. Thus the addition of lactulose to the diet of elderly can effectively create soft bowel movements and regularity. Lactulose has potential therapeutic application in the treatment of constipation and other intestinal disorders. In spite of the recognized large potential of lactulose and a reasonable amount consumed every year, there is no such unit as to manufacture this nutraceutical product locally.

**Objectives:**

- To provide an economically feasible improved process for the manufacture of lactulose locally.
- Development of food supplements and pharmaceutical formulations for commercialization purpose.

**Present Status:** On-going

**Targets for 2019-20:**

- Synthesis of lactulose on laboratory and pilot plant scale.
- Preparation of formulation in syrup form.
- Commercialization of the process.

<b>Title:</b>	<b>Mycotoxin Control in Post Harvest Cereals</b>	
<b>Project Leader:</b>	Dr. Arshad Hussain, PSO	
<b>Project Associates:</b>	Mr. Ziaur Rehman, ST	Mr. Muhammad Mushtaq, ST
<b>Year of Initiation:</b>	2018	
<b>Duration:</b>	02 Years	

**Background:**

Mycotoxins are secondary metabolites, which are produced by several fungi mainly belonging to the *Aspergillus*, *Penicillium*, *Fusarium*, and *Alternaria* genera. The main mycotoxins currently considered include aflatoxins, tricothecenes, zearalenone, fumonisins and ochratoxin A. They occur in various commodities, such as cereal grains, pulses, dried fruits, nuts, milk and dairy products. The acute effects of mycotoxins / neurotoxins are on central nervous system causing depression, unconsciousness, arrest of respiratory system and ultimately death. Chronic effects include alteration of nervous tissue structure and function, tumor formation, staggering, tremor etc. Pakistan is situated in subtropical region and its environment is conducive of mycotoxin production. It constitutes several contamination problems in agricultural products and has shown to be responsible for acute and chronic toxic effects in animals as well as in human beings. The problem of food contaminated by mycotoxin is of current concern and has received great deal of attention now a day. Increase in mycotoxin contamination of cereals and edible nuts cause concerns among producers and consumers; hence the availability of reliable and feasible techniques for toxin free food is essential.

**Objectives:**

- To preserve cereals during storage from mycotoxin contamination and to restore its quality.
- To enhance marketability and profitability of cereals and their products.
- To develop technique / process for mycotoxin reduction, that will improve public health, increase agricultural trade and enhance food security.

**Present Status:** On-going

**Targets for 2019-20:**

- Evaluation of mycotoxins in selected cereals.

- Re-evaluation of decontaminated cereals.
- Documentation of data in the form of patent, technical report / research article.

**Title:** **Eco-Friendly Management of Fungal Seed Borne Pathogens Through *Trichoderma harzianum***

**Project Leader:** Dr. Javid Ali, SSO

**Project Associates:** Mr. Inaytur Rehman SO      Mr. Shamsur Rehman, PSO  
Mr. Muhammad Ilyas, Sr.Tech.

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

All over the world soil borne plant pathogenic fungi cause heavy crop losses. Crop growing has been facing the destructive activities of several pathogens and pests from an early time, which leads not only to the decline of crops yield but also the aesthetic value. Synthetic control of such crop pathogens disturbs the ecology, degrades soil productivity, environment and mismanages water resources. Further due to the growing cost of pesticides, especially in the poor countries of the world like Pakistan as well as customer demands for non-pesticide food has led to look for the alternatives for these products. Biological control of crops diseases, particularly those caused by nematodes and soil borne crops pathogens, by micro-organisms has been measured environmentally acceptable and more natural alternative to the accessible synthetic treatment methods. The new attention in biocontrol among agriculture bio-technologists is due to its environment friendly defense against crop diseases, insects and weeds, a safety features and a long lasting effect. *Trichoderma* species is measured as potential biological control agents against various phytopathogenic fungi since it is capable to reduce the phytopathogenic fungi either by plant defense reaction or including resistance or by direct altercation through competition and mycoparasitism or by antibiotics production. *Trichoderma* species has been well thought-out a practical substitute technique to handle crop diseases. The function of *Trichoderma* species is not only to manage the pathogenic microbe's growth, there are other diverse applications for *Trichoderma* species like, it stimulates plant growth, root growth, colonization of rhizosphere and enhances plant defense responses.

**Objectives:**

- Isolation of *Trichoderma harzianum* from local indigenous resources.
- Selection and optimization of low cost substrate for the mass production of *Trichoderma harzianum*.
- Formulation of *Trichoderma harzianum* with different carrier.
- Shelf life of *Trichoderma harzianum* formulations.
- Effect of *Trichoderma harzianum* on the growth of *Aspergillus flavus*, *Aspergillus niger*, *Fusarium oxysporum*, *Rhizoctonia solani*, *Pythium aphanidermatium*, *Fusarium culmorum*, *Gaeumannomyces graminis var. tritici*, *Sclerotium rolfsii*, *Phytophthora cactorum*, *Botrytis cinerea* and *Alternaria* species.
- To evaluate seeds (carrot, radish, tomato and lady finger) for the incidence of mycoflora.
- To assess the effect of treatments on seed germination.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Purchase of raw materials and chemicals.
- Isolation, characterization and identification of *Trichoderma harzianum*.
- Mass production of *Trichoderma harzianum* through different techniques.
- Optimization of different parameters (media, substrate, temperature, pH etc.).
- Application of different formulation techniques/methods for the *Trichoderma harzianum* based biofungicide.

**Title:** Technology Development of Grafted Polychloroprene Rubber Adhesive

**Project Leader:** Dr. Mahmood Iqbal, SSO

**Project Associates:** Mr. Qazi Muhammad Sharif, SSO  
Mr. Sohail Noor, ST

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

Polychloroprene is the synthetic rubber also known as neoprene. Chloroprene rubber has many superior characteristics compared to natural and even other synthetic rubbers. Chloroprene rubber is resistance to ozone, oil and heat. About one third of polychloroprene rubber is used as a raw material for adhesives (both solvent-based and water-based). Solvent based polychloroprene adhesives play a substantial role in bonding the different substrates in the shoe, due to some specific features of the structure of the chloroprene rubber. These adhesives are used for bonding high pressure laminates, automotive trim, roofing-membrane attachment, furniture, kitchen cabinets, custom display cabinets, interior and exterior panels, wall partitions, shoe soles, and many other applications where quick, high strength, permanent bonds are needed. Few batches of polychloroprene rubber adhesive were prepared and their adhesion properties were evaluated. The results are encouraging. The degree of grafting will be further increased in order to improve the adhesion.

**Objectives:**

- To prepare methyl methacrylate graft-chloroprene rubber adhesive.
- To utilize indigenous facilities and resources for the preparation of methyl methacrylate-graft-chloroprene rubber adhesive.
- Developments of products with enhanced physical properties at low cost

**Present Status:** On-going

**Targets for 2019-20:**

- Synthesis of methyl methacrylate graft-chloroprene rubber adhesive.
- Characterization of the prepared adhesive

<b>Title:</b>	<b>Preparation of Investment Material for Dental Castings</b>
<b>Project Leader:</b>	Mr. Qazi Muhammad Sharif, SSO
<b>Project Associates:</b>	Mr. Amin Ur Rahman, SSO Engr. Waheed Ur Rehman, JE
<b>Year of Initiation:</b>	2017
<b>Duration:</b>	03 Years

**Background:**

Dental prostheses are generally made by investment casting. This method is also used for making of small parts of metal, glass and ceramic materials. The choice of investment material depends on the nature of cast material and the rate of temperature rise during burn out. Quick heating can cause cracks in the molds due to rapid loss of volatile and heat differential. For the control of cracks the conventional casting materials are heated very slowly. Attempts are being made to formulate material having additives to produce pores in the mold to increase gas permeability for volatiles. The escape of volatiles prevents the cracks and subsequently rapid heating is possible without damage of the mold. Alternatively, the permeability is controlled by changing the basic raw material without additive. Indigenous materials will be characterized and evaluated for the use in preparation of mold material. The effect of size and ratio of component materials i.e. binder, refractory and modifiers will be studied for the right balance of gas permeability, set time and smoothness etc. Parameters will be optimized for the formulation of defect free molds for dental material. Import figures: HS code accumulative assessed import figure was 783,990 US \$ from January 2016 to February 2017 as per FBR website. Huge amount of this material also comes through other channels.

**Objectives:**

- Development of process for the preparation of investment material for dental casting.
- Utilization of indigenous raw materials.
- To save foreign exchange being spent on the import of such types of material.

**Present Status:**

- Chemical analysis of prepared samples DCM-1 & DCM-2 showed to be in good agreement with standard NCC material. Optimized the formulation of DCM-1 for lab scale parameters.



**Targets for 2019-20:**

- Preparation of dental casting material.
- Characterization and evaluation of prepared product.
- Establishment of pilot plant set up for dental casting materials.

**Title:** Preparation of Acetate Chemicals from Indigenous Dolomite

**Project Leader:** Ms. Asma Yamin, SSO

**Project Associates:** Engr. Waheed Ur Rahman, JE

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Our country specially the province of KPK has been blessed with mineral wealth i.e. metallic and non metallic minerals. These minerals have wide applications in the mineral based industries. Dolomite is soft sedimentary rock forming mineral composed of calcium magnesium carbonate. It is found in Hazara and Swabi. Dolomite products are utilized in cement manufacturing, metallurgy and agriculture (fertilizers, fungicides, animal feed). Other uses include: construction, manufacturing, flue gas de-sulphurisation, adhesives, insulation and pH control. Dolomite is used as a source of magnesia (MgO), a feed additive for livestock, a sintering agent and flux in metal processing, and as an ingredient in the production of glass, bricks, and ceramics. It is worth mentioning that most of the mineral based dolomite materials and chemicals such as calcium and magnesium salts of chloride, sulphate, carbonate, bicarbonate, nitrate, acetate and polyphosphate have great potential in view of growing demands for these products by a variety of industries, like chemicals, food, pharmaceuticals, dyes, paints, pigments, rubber, plastics, paper and leather etc. Among acetate salts, calcium acetate, magnesium acetate and calcium magnesium acetate are considered to be the salts of industrial importance. In kidney disease, blood levels of phosphate may rise (called hyperphosphatemia) leading to bone problems. Calcium acetate binds phosphate in the diet to lower blood phosphate levels.

**Objectives:**

- To establish processes for the production of acetate chemicals from dolomite.

- To scale up the bench scale studies for the production of these products so as to substitute their imports.
- Development of technology for semi/large scale production and their onward commercialization.

**Present Status:**

- 70 % Calcium magnesium acetate has been prepared from dolomite ore on the lab scale. For finding out the optimum condition for the preparation of calcium magnesium acetate, the studies are in progress.

**Targets for 2019-20:**

- Upgradation of bench scale process to semi/pilot plant scale.
- Preparation of technical/technoeconomic feasibility reports.
- Commercialization of pilot plant processes.

**Title:** Beneficiation of Manganese Ore of Chura Gally, Mansehra

**Project Leader:** Engr. Waheed-Ur-Rahman, JE

**Project Associate:** Mr. Amin-Ur-Rahman, PSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Manganese is used in steel making as a powerful reducing, desulfurizing and dephosphorizing agent. It forms stable dioxide ( $MnO_2$ ), sulphide ( $MnS$ ) and phosphide ( $MnP$ ). High grade manganese ore having a high content of  $MnO_2$  is generally utilized in battery industry. Ore containing at least 45% manganese with Mn/Fe ratio of 7 is utilized in the manufacturing of ferro-alloys. Ore having too low Mn/Fe ratio can be employed for the manufacture of spiegeleisen. Manganiferous ore containing 12% or less manganese can be used directly for making manganese pig iron. Manganese ores containing more than 35% manganese are considered to be profitable. The world production of manganese ore and concentrates is estimated to be  $17 \times 10^6$  tonnes. The total reserves of manganese in Pakistan are estimated to be 0.5 million tonnes. Annual production varies from 100 to 600 tonnes. Important reserves in the

south are in Lasbela, Siro (Karachi), Snjro Dhora (Kallat), Khabri and Dadi Dhora. These deposits constitute ~97% of the country's total reserves. Beneficiation of manganese ore is possible by either chemical or physical means. The chemical methods are leaching and electrolysis. The physical methods are wet screening, gravity concentration, magnetic separation and flotation. The present project is intended to upgrade the manganese ore of Chura gally (Mansehra) through suitable physical techniques.

**Objectives:**

- Upgradation of manganese ore of Chura Gally, Mansehra, through optimized beneficiation techniques up to an expected manganese concentration of 40-50%.
- Increasing the economic and commercial value of the indigenous manganese ore.
- Technology offer to the local investors for commercial exploitation of the manganese ore.

**Present Status:**

- The raw ore containing 15% Mn has been studied for its amenability to beneficiation through wet sieving and magnetic separation. These studies show no substantial enrichment and recovery. Further work on flotation studies will be carried out.

**Targets for 2019-20:**

- Raw ore analysis and characterization.
- Wet sieving studies.
- Magnetic separation studies.
- Froth flotation studies.

**Title:** Preparation and Characterization of MXene/Polymethyl Methacrylate Nano-composites

**Project Leader:** Dr. Mahmood Iqbal, SSO

**Project Associates:** Mr. Qazi Muhammad Sharif, SSO  
Mr. Sohail Noor, ST

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Two dimensional materials due to their outstanding properties have been a major research area in materials science. MXenes are a class of two dimensional inorganic compounds. These materials consist of few atoms thick layers of transition metal carbides, nitrides, or carbonitrides. First described in 2011, MXenes combine metallic conductivity of transition metal carbides and hydrophilic nature because of their hydroxyl or oxygen terminated surfaces. MXene shows a higher antibacterial efficiency toward both gram-negative *E. coli* and gram-positive *B. subtilis*. Colony forming unit and regrowth curves show that more than 98% of both bacterial cells lost viability at 200 µg/mL  $Ti_3C_2$  colloidal solution within 4 h of exposure. Damage to the cell membrane occurs, which results in release of cytoplasmic materials from the bacterial cells and cell death. The principal *in vitro* studies of cytotoxicity of 2D sheets of MXenes show promise for applications in bioscience and biotechnology. Gaseous molecules cannot be readily adsorbed onto MXene surface. Intrinsically MXene is insensitive and its sensitivity can be dramatically enhanced by functionalizing MXene, for example, coating with a thin layer of certain polymers. The thin polymer layer acts like a concentrator that absorbs gaseous molecules. MXene will be synthesized. The prepared MXene will be used in the preparation of MXene/PMMA nano-composite.

**Objectives:**

- To employ indigenous facilities and resources for the preparation of MXene
- Characterization of MXene by scanning electron microscopic
- To prepare MXene/polymethyl methacrylate (PMMA) nano-composites
- To determine its properties like mechanical strength, flexibility, and electrical conductivity.

**Present Status:**

- Research Paper has been submitted for publication.

**Targets for 2019-20:**

- Synthesis of MXene.
- Synthesis of MXene/polymethyl methacrylate nanocomposites.
- Characterization of the prepared nanocomposites.
- Compilation of data in the form of research papers and patent.

**Title:** **Preparation of Sodium Nitrate from Commercial Grade Chemicals and Allied Products**

**Project Leader:** Ms. Asma Yamin, SSO

**Project Associates:** Mr. Amin Ur Rehman, PSO  
Mr. Qazi Muhammad Sharif, SSO  
Eng. Waheed-Ur-Rehman, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Sodium nitrate is the chemical compound with the formula  $\text{NaNO}_3$ . This alkali metal nitrate salt is also known as Chile saltpeter to distinguish it from ordinary saltpeter, potassium nitrate. The mineral form is also known as nitratine, nitratite or soda niter. The largest accumulations of naturally occurring sodium nitrate are found in Chile and Peru, where nitrate salts are bound within mineral deposits called caliche ore. Sodium nitrate is a white solid and is soluble in water. It is a readily available source of the nitrate anion ( $\text{NO}_3^-$ ), which is useful in several reactions carried out on industrial scales for the production of fertilizers, pyrotechnics and smoke bombs, glass and pottery enamel sand solid rocket propellant. Sodium nitrate is also a food additive used as a preservative and color fixative in cured meats and poultry. Less common applications include oxidizers in fireworks, replacing potassium nitrate commonly found in black powder, and as a component in instant cold packs. Sodium nitrate is used together with potassium nitrate and calcium nitrate for heat storage and, more recently, for heat transfer in solar power plants. A mixture of sodium nitrate, calcium

nitrate and potassium nitrate is used as energy-storage material in prototype plants, such as Andasol Solar Power Station. Sodium nitrate is also sometimes used by marine aquarists who utilize carbon-dosing techniques. It is used to increase nitrate levels in the water and promote bacterial growth. At present Pakistan fulfills most of its requirement through the import from other countries despite the fact that the raw materials are available indigenously within the country. Due to its application in many industries and in order to save the foreign exchange the project is initiated on the demand of industry.

**Objectives:**

- Development of process for the economical preparation of sodium nitrate at low cost.
- To meet the increasing demand of sodium nitrate in the country.
- To cut down the import of the said commodity and thus saving the valuable foreign exchange.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Purchase of raw materials.
- Synthesis of  $\text{NaNO}_3$ .
- Characterization/ testing of the product.
- Upgradation of bench scale product to semi pilot plant.

**Title:** **Technology Development for Production of Soundless Chemical Demolition Agent (SCDA) from Indigenous Materials**

**Project Leader:** Engr. Waheed Ur Rahman, JE

**Project Associates:** Mr. Qazi Muhammad Sharif, SSO  
Engr. Mahtab Afridi, JE  
Mr. Sohail Noor, ST

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

The traditional approach to demolish concrete structures or to reduce the sizes of large rocks has typically included the use of explosives. The resulting explosions are associated with the obvious risks posed by shock waves and fly rock. These, along with other detrimental side effects of using explosives, have increased an interest in the use of alternative methods to demolish rock and concrete structures. Soundless chemical demolition agents (SCDAs) have proven to be viable substitutes for the use of explosives. SCDAs are powdery materials that will expand considerably when mixed with water. This expansion, when occurring under confinement, generates significant expansive pressures. These pressures are sufficient to break up rock and concrete when the SCDA is confined in a borehole or a series of boreholes. The preparatory procedures involved in using SCDAs are similar to those followed in traditional blasting techniques. As with explosives, boreholes must be drilled to contain the SCDA. Beyond this, however, the similarities diminish. The SCDA must be mixed with a measured quantity of water and poured into the boreholes. It will then begin to hydrate, generating heat and crystallizing, while hardening and expanding. If hydration takes place under confinement, significant expansive pressure will result. The pressures can be of sufficient magnitude that, after a period of time, they will fracture the confining material. Depending on the type of SCDA, significant expansive pressure may be generated as quickly as within 15 min., or as long as within 24 hrs. In the proposed project technology/process will be developed for the production of SCDA from indigenous raw materials which are currently being imported in Pakistan.

**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.

**Present Status:**

- Sample concrete blocks were prepared for testing of soundless chemical demolition agent. The demolition agent will be tested in block size of 12”x6” with 3 holes.

**Targets for 2019-20:**

- Optimization of process parameters.
- Initial testing of developed product.

**Title:** Preparation of Organic Fertilizer and other Useful Products from Vermiculite Ore

**Project Leader:** Mr. Jehangir Shah, PSO

**Project Associates:** Mr. Amin Ur Rehman, PSO  
Dr. MahmoodIqbal, SSO  
Mr. Qazi Muhammad Sharif, SSO  
Engr. Waheed Ur Rehman, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Vermiculite is a clay mineral group with the general chemical composition  $(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4(H_2O)$ . Often occurring as an alteration product of biotite mica or chlorite in the near-surface zone of weathering, vermiculite is typically found associated with ultramafic rock types such as peridotite and pyroxenite that have been previously altered by intrusions of granite, pegmatite or alkalic rocks. Vermiculite occurrences have been documented in several areas in the Piedmont province of Virginia within Buckingham, Bedford, Charlotte, Franklin, Halifax, Henry, Louisa, and Pittsylvania Counties. To date, only one of these occurrences, in Louisa County, has been developed as a commercial deposit. As a hydrous mica-like mineral,



vermiculite expands rapidly when heated to temperatures  $>900^{\circ}$  C. The contained water converts to steam forcing individual mineral laminae apart, a process known as exfoliation. The expansion results in low density mineral granules that can be 6-20 times the original volume. These granules are chemically inert, refractory and highly absorptive, making the material highly valued in construction applications such as plaster and cement premixes, lightweight concrete additives, as an industrial absorbent and in fireproof and sound insulation. Depending on the specific chemical composition, vermiculite may also be characterized by high cation exchange capacity making it valuable in agricultural and horticultural products.

**Objectives:**

- Development of economically feasible products from Vermiculite ores.
- Efforts would be made to analyze the Vermiculite ore.
- Use of Vermiculite ore for the development of agriculture fertilizer, different molds, calcium silicate boards, insulating materials for building roofs and other useful products keeping in view of its chemical and physical properties.

**Present Status:**                      New Project

**Targets for 2019-20:**

- Characterization of vermiculite ore.
- Development of different products based on its physio-chemical properties.
- Development of products at pilot plant level.
- Efficiency study of the product.
- Data evaluation, documentation and commercialization.

**National Physical and Standard Laboratories, (NPSL)**

**Title:** Fruit Peels Extract as Natural Food Preservative Against Pathogenic Bacteria from Processed Food

**Project Leader:** Ms. Ambreen Akhtar Saddozai, SSO

**Project Associates:** Dr. Naseem Rauf, PSO      Dr. M. Tahseen Aslam, SSO  
Ms. Fouzia Hussain, SO      Ms. Razia Kalsoom, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Considerable amount of solid wastes in the form of peels and seeds are generated by the fruit processing industries. These wastes are not disposed off correctly but seen to cause serious environmental problems such as water pollution, unpleasant odours and combustion. There are several reports highlighting the integral exploitation of bioactive compounds from these wastes and their potential applications as antioxidant, antimicrobial and flavouring. Solid wastes particularly from processes such as peeling and coring typically have a high nutritional value. They have also been reported to contain antimicrobial properties. Antimicrobial activity of various fruit extracts has been tested against various micro-organisms like bacteria and fungi. Generally, gram negative bacteria are more resistant than gram positive bacteria. Food products can be contaminated by a variety of pathogenic and spoilage microbiota, the former causing foodborne diseases and the latter causing significant economic losses for the food industry due to undesirable effects on the food properties. Microbial food spoilage is also an area of immense concern for the food industry. It is estimated that as much as 25% of all food produced is lost after harvest due to microbial activity. While the growth of spoilage microbiota in foods is not harmful for the human health, it has negative impact on the shelf-life, textural characteristics, and overall quality of the finished products. Thus, prevention or inhibition of microbial growth in foods is of outmost importance for the current globalized food production. There is still the need for new processing methods, to be used either alone or in combination with the already existing ones, able to reduce or eliminate foodborne pathogens and spoilage bacteria. Chemical additives have been extensively used to prevent the survival and proliferation of micro-organisms, but these chemical additives that are used in food industries are considered to be potentially harmful

to human health and have demonstrated various adverse effects on the human health including allergy, headache, asthma, and dermatitis. Since the reduction or elimination of pathogens and spoilage micro-organisms in food is the foremost priority, the current trends in food processing are focusing on the use of natural compounds, which are considered as safe alternatives and satisfy the consumer preferences existing ones, able to reduce or eliminate foodborne pathogens and spoilage bacteria. Recent studies on the utilization of natural antioxidants (e.g., herbal essential oils and extracts) indicate their capacity and safety. Also, the antimicrobial properties of natural substances such as plant essential oils and extracts have been extensively studied with promising results. The proper recycling and use of fruit processing plants by products like fruit seeds or skins discarded and piling up in huge amounts every year, are of great interest for the food industry. Therefore, most of the developing countries are focusing on the implementation of natural antimicrobial and antioxidant substances for preserving food. Considering all the factors mentioned above, present study is designed to investigate possible use of different fruit peel extracts (natural substances) to be efficiently used as an antimicrobial agent with an ultimate objective of developing substitutes for the synthetic chemical additives in food products and their effects on organoleptic properties and shelf life.

**Objectives:**

- To determine the antimicrobial activity of different fruits peel against pathogens at different concentration.
- To utilize the best peel powder concentration in selected fruit products.
- To study the efficacy of peel powders on sensory and microbiological characteristics of food products stored at refrigerated temperature.

**Present Status:** New project

**Targets for 2019-20:**

- Collection and processing of sample.
- Selection/determination of suitable methodology for converting the different fruit peel samples into powder.
- Application of different fruit powder for antimicrobial resistance such as *Staphylococcus aureus*, *E.coli*, *Salmonella* etc.
- Utilization of the best peel powder concentration in selected fruit products.
- Technical report/ research paper publication.

**Title:** Aflatoxin B1 (AFB1) Reference Material (RM) and Optimization of Analytical Methodology for the Accurate Measurement of AFB1 in Food Matrix

**Project Leader:** Dr. Muhammad Tahseen Aslam, SSO

**Project Associates:** Dr. Naseem Rauf, PSO Ms. Ambreen Saddozai, SSO  
Ms. Fouzia Hussain, SO Ms. Razia Kalsoom, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Mycotoxins are chemically diversified low molecular weight compounds produced as secondary metabolites of fungal genera such as *Aspergillus*, *Penicillium*, *Fusarium*, *Alternaria* and *Claviceps* over a variety of food stuff having deleterious biological effect in animal and human. Mycotoxins tend to contaminate food stuffs in the tropics and semi-tropics, where high temperature and humidity are optimal for the growth of molds and production of toxins when food is growing, harvested and finally stored. Humans are exposed to mycotoxins throughout their life time due to consumption of fungus contaminated food products. Sufficient quantities of mycotoxins in food and feed stuff can adversely affect human and animal health. However, the toxic effect varies depending on intake dose, toxin type, duration of exposure, metabolism, mode of action, and defense mechanism. Many human diseases, especially carcinogenic, teratogenic, hepatic, and gastrointestinal ones, have been found linked with the ingestion of Mycotoxins-contaminated products. Aflatoxins are a group of closely related mycotoxins that are mainly produced by the fungi *Aspergillus flavus* and *A. parasiticus* through a polyketide pathway. The term “aflatoxin” comes from three words: (i) the “a” that represents the *Aspergillus* genus; (ii) the “fla” that represents the species *flavus*; and (iii) the “toxin” that means poison until now, eighteen different types of aflatoxins have been identified. Aflatoxin B1 (AFB1) produced by *A. flavus* and *A. parasiticus*, is intrinsically fluorescent due to the presence of a chain of conjugated bonds and heteroatoms within the molecule, and their intrinsic fluorescence can be used for determination. AFB1 and AFB2 ingested by mammals can produce respective Aflatoxin M1 (AFM1) and Aflatoxin M2 (AFM2), which are two important Aflatoxin species. Approximately 0.3–6.2% of AFB1 in animal feed is transformed into AFM1 in milk. The name ‘M’ indicates the original derivation from milk. It has been reported that AFM1 and AFM2 exhibited blue-violet

and violet fluorescent on thin-layer chromatography (TLC) plates under ultraviolet light, respectively and the fluorescence intensities of the AFM1 and AFM2 were three times stronger than those of the respective AFB1 and AFB2. The main food products susceptible to Aflatoxin contamination are peanuts, maize, pistachio nut, cottonseed, copra and spices, among others. In Pakistan various cases of mycotoxin contamination of agricultural products has been reported, and highlighting the fact that major portion of our crops are under stress due to fungal contamination, that's why Pakistan needs to control mycotoxin production in crops in order to generate revenue by exporting. The present study aims to develop/optimize analytical methodology for testing and reference material of Aflatoxin (AFB1) by using indigenous facilities.

**Objectives:**

- To optimize existing analytical methodology for the assessment of mycotoxins specially AFB1 by HPLC.
- To develop reference material of aflatoxin (AFB1).
- To study the reliability and accuracy of analytical measurements/results.
- To explore new collaboration opportunities with international metrological organizations.

**Present Status:**                      New Project

**Targets for 2019 – 20:**

- Development of new methodology for the characterization of AFB1 by HPLC.
- Optimization of the newly developed analytical methodology for the determination of AFB1 by using HPLC-FLD.
- Preparation of in-house reference material i.e homogeneity testing, stability testing, uncertainty measurement of the samples.
- Participation in key comparisons conducted by different international metrological organizations like NIM China etc. (if any).
- Technical report / research publication.

**Title:** Extraction, Characterization and Standardization of Active Ingredients from Indigenous Medicinal Plants of Pakistan and its Applications for the Treatment of Skin Diseases

**Project Leader:** Dr. Naseem Rauf, PSO

**Project Associates:** Ms. Ambreen Saddozai, SSO  
Ms. Fouzia Hussain, SO  
Ms. Razia Kalsoom, SO

**Year of Initiation:** 2016

**Duration:** 04 Years

**Background:**

Psoriasis is believed to be an immune mediated disease which affects the skin and joints. It is a genetically determined chronic inflammatory skin disease characterized by red, scaly and raised patches that affects 2.3% of the population worldwide. In the present study, an attempt will be made to evaluate the prevalence of this disease in people of different regions of Pakistan. Serum samples will be collected from around 500 psoriatic patients and their trace/ toxic metals profile will be assessed with those of healthy control group. Ethno-medicinal studies will be carried for *Moringa oleifera* in terms of its vitamin contents, flavonoid, alkaloid, trace elements etc. The study will include the induction of Psoriasis in male albino rats skin by UV rays. The treatment will be given to the rats, having psoriasis developed through induction of UV rays with the extracts of different parts of *Moringa oleifera*. Histopathological studies will be carried out for the infected and the treated skin to evaluate any significant achievement/ improvement of these animals towards psoriasis by using these plant extracts. Psoriasis makes an impact on the social and mental health of the patients. There is a common misperception that skin diseases are somehow less serious than other medical illnesses. This can be attributed, in part, to the fact that skin disorders are often chronic but not life threatening, and so the perceived impact on the patient is more likely to be minimized in the minds of health professionals, third party payers, government policy makers, and the general public. All types of psoriasis, ranging from mild to severe, can affect a person's quality of life. The impact of psoriasis on patient health related quality of life (HRQOL) is profound and has been well documented in the scientific literature. Psoriasis, as well as the therapies necessary to control it, can influence many different spheres of a patient's life, including career, finances, leisure activities, relationships, and physical intimacy.

The subsequent effects on a patient's social and mental health can be dramatic. Patients with psoriasis often experience physical and emotional disabilities that can severely impact their quality of life. Nearly 60% of patients with psoriasis report that the disease is a large problem in their everyday life, and 26% indicate they have been forced to change or discontinue their normal daily activities because of moderate or severe psoriasis. Psoriasis patients with such experiences lack confidence and feel angry, frustrated, and embarrassed. Keeping in view these facts, we will try to find an efficient, cheap and herbal remedy for the treatment of psoriasis.

**Objectives:**

- To evaluate and assess the serum micronutrients level in patients with psoriasis.
- To compare the levels of serum micronutrients of the patients with those of apparent healthy subjects.
- To advance our understanding of the pathogenesis of the disease, and possibly come up with new approaches to its diagnosis, management and treatment.
- To fill the gap, open new forum of discussion and to provide knowledge and information regarding the medical workup of patients with psoriasis.
- Ethno medicinal studies/ profile of the medicinal plant used for this study.
- Synergistic effect of indigenous medicinal plant extracts on psoriasis.

**Present Status:**                      On-going

**Targets for 2019 - 20:**

- Induction of psoriasis in male Swiss albino rats.
- Application of different plant extracts onto male Swiss albino rats with the collaboration of National Institute of Health (NIH), Islamabad.
- Histopathological studies to check any improvement of psoriasis on the skin of experimental rats.
- Statistical analysis, compilation of data and its publication at international level.

**Title:** **Assessment of Heavy Metals Concentration in Cosmetic Products Being Imported and Locally Available in Rawalpindi/ Islamabad, Pakistan**

**Project Leader:** Ms. Razia Kalsoom, SO

**Project Associates:** Dr. Naseem Rauf, PSO      Dr. Tausif Chaudhry, SSO  
Ms. Ambreen Saddozai, SSO Ms. Fouzia Hussain, SO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Cosmetics are used in contact with various parts of the human body such as face, eyes, hair, nails and lips or applied to the teeth for the purpose of cleaning, perfuming, protection, changing their outlook, converting body odours and keeping the surfaces in good condition. Cosmetics are mixtures of some ingredients such as surfactants, oils and they need to be effective, long lasting, stable and safe to human use. The various forms of cosmetics include powders, creams, lipstick and lip gloss, mascara, nail polish, eye liner and eye shadow. Cosmetics, especially the skin lightening types are used widely in most Pakistani cities, especially by women. Since these products are used for a long time, on a large body surface and under hot humid conditions, cutaneous absorption is enhanced. The complications of these products can be very serious. Some studies have indicated an association between some ingredients of cosmetics and a variety of health problems. According to a current media news report, London Trading Standards cracked down on some cosmetic products being sold in the United Kingdom. Most of them were skin whitening or “beauty creams” products as they are well known around here. They were charged for selling unreliable beauty products that are harmful to the skin. These creams can cause cancer and organ damage and other diseases. Among them were famous brands that are used at a large scale in Pakistan. Continuous use of these products can cause skin discoloration and thinning of skin. Some of those even contained chemicals that can affect organ damage and cancer. Most of the metals act as endocrine disrupters interfering with the hormonal system.

**Objective:**

- To investigate the concentration of some heavy metals like copper, manganese, nickel, chromium, cadmium and lead in cosmetic products i.e. skin whitening cream, face powder



and lipsticks available in Rawalpindi/ Islamabad region.

**Present Status:** On-going

**Targets for 2019-20:**

- Preparation of calibration curves.
- Sample analysis on ICPMS.
- Statistical analysis.
- Report writing / publications.

**Title:** **Development of Indigenous Sustainable Technology for the Treatment of Surface Water to Use it for Drinking Purpose**

**Project Leader:** Dr. Muhammad Tahseen Aslam, SSO

**Project Associates:** Dr. Naseem Rauf, PSO      Mr. Afzal, JEO  
Mr. Fayyaz, JTO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Surface water is the water on the surface of the planet such as in a river, lake, wetland, or ocean. The total quantity of water on earth is estimated to be 1.4 trillion cubic meters. Of this less than 1% water present in rivers and ground water resources is available to meet our requirements. It is projected that water usage will increase more than 50% from 2007 to 2025 in developing countries and in developed country, it will increase 18% in the same period. The sources of fresh water in Pakistan are glaciers, rivers, lakes and snow falls. In Pakistan, four major cities have been using surface water, these include Islamabad, Karachi, Rawalpindi and Hyderabad. The surface water should be treated efficiently to make it safe for drinking purpose. Natural water always contains dissolved and suspended substances of organic and mineral origin. The following water quality parameters will be analyzed using standard methods: temperature, pH, colour, odour, turbidity, EC (Electrical Conductivity), hardness, TDS (Total Dissolved Solids), SS (Suspended Solids), BOD, COD, Dissolved Oxygen (DO). Pakistan is suffering from water shortage. To overcome this situation, there is a need to use surface water. It is a valuable

natural resource for various human activities. In Pakistan, surface water have been noted to be unsafe for drinking purpose due to pollution caused by urbanization, industrialization and poor solid waste management system. It is a need of the time to shift our focus from ground water to surface water in regard of water resource for drinking water. The aim of the project is to develop an indigenous sustainable technology for the treatment of surface water to make it fit for human consumption.

**Objectives:**

- To assess the surface water quality of different rivers in Pakistan.
- To quantify the major impurities.
- To apply established technologies to remove pollutants from surface water for drinking purpose.
- To develop efficient and economical filtration system, suitable for Pakistan surface water.

**Present Status:** On-going

**Targets for 2019-20:**

- Sample collection from different rivers according to standard methods.
- Characterization of collected samples.
- Selection of parameters to be treated.
- Treatment of the impurities according to the literature review.
- To design efficient filtration system on laboratory scale.
- Different trials will be tested on lab scale system.
- The actual samples will be tested on finalized reactor.
- The prototype treatment plant will be designed and constructed in NPSL lab on the basis of laboratory scale treatment system.
- The polluted water from different areas of Pakistan will be collected and tested on the treatment plant.
- The results will be compiled and report submitted at the end of this quarter in a peer reviewed journal.

## **PCSIR Laboratories, Quetta**

**Title:** Development of Biotechnological Process for Production of Cellulase

**Project Leader:** Mr. Junaid Ahmed, SO

**Project Associates:** Mr. Mujeeb ur Rahman, CSO  
Ms. Hiba Amanat Ali, SO

**Duration:** 03 Years

**Year of Initiation:** 2017

### **Background:**

Cellulases are currently the third largest industrial enzymes worldwide, due to their wide applications in cotton processing, paper recycling, juice extraction, as detergent enzymes and animal feed additives. However, cellulases may reach the largest volume of industrial enzyme; if ethanol from lignocellulosic biomass through the enzymatic route becomes potentially possible for transportation fuel. Cellulolytic enzymes are produced by a variety of bacteria, fungi, actinomycetes, aerobes and anaerobes. Each of these micro-organisms can produce different kinds of cellulases that differ in their mode of action as well as properties like activity towards crystalline cellulose, activity and stability in acidic or alkaline pH. The most privileged sources for the production of cellulases are fungi, due to their higher enzyme yields and capacities to produce complete cellulase complex. Cellulases have found a wide range of other applications in coffee processing, textile industry and in laundry detergents, pulp and paper industry, pharmaceutical industry, biofuel industry etc. Large demand of cellulases has increased their prices to a large extent. It is need of the time to search for cheaper substrates and reduced fermentation cost so that the production cost can be reduced to a large extent. From the compositional studies it has been established that it could be transformed into sugar unit which can be subsequently processed to get a large number of useful products like bio-fuels, alcohols, chemicals, pharmaceutical products, industrial solvents etc. Various methods are available to transform cellulosic biomass into value added product, which basically needs hydrolysis. This hydrolysis process could be done by acid and /or enzyme. Bio-technological conversion of cellulosic biomass is potentially sustainable and eco-friendly approach to develop novel bio-processes and products. The availability of a highly active cellulase is the prime requirement for

a successful process of enzymatic conversion of cellulose into useful product. This depends on proper selection and improvement of suitable strains for enzyme production and development of the process for production of enzyme of high quality.

**Objectives:**

- To develop a suitable process for producing cellulase enzyme using low cost waste material.
- To provide base for setting up of local bio-processing industries based on indigenous resources.
- This project will also pave the way for utilization of one of the abundantly available organic compound on biosphere.
- To ensure the continuous supply of enzyme for local use and for export to earn foreign exchange.

**Present Status:**

- Selection of high enzyme producing strain by solid substrate and submerged fermentation.
- Growth parameters studies of the selected strain by solid substrate/submerged fermentation.

**Targets for 2019-20:**

- Growth parameters studies of the selected strain by solid substrate/submerged fermentation.
- Effect of temperature on growth of isolate.
- Effect of pH on growth of isolate.
- Isolation and characterization of enzyme.

**Project Title:** **Antidiabetic and Antioxidant Potential of Medicinal Plants of Balochistan**

**Project Leader:** Ms. Hiba Amanat Ali, SO

**Project Associates:** Mr. Mujeeb ur Rahman, CSO  
Mr. Junaid Ahmed, SO

**Year of Initiation:** 2018

**Duration:** 03 Years

**Background:**

Medicinal plants continue to be an important therapeutic aid for alleviating ailments of humankind. Over the last 2500 years, there have been very strong traditional systems of medicine such as Chinese, ayurvedic, and the Unani, born and practiced, more in the eastern continent. These traditions are still flourishing, since; approximately 80% of the people in the developing countries rely on these systems of medicine for their primary health care needs. These plants contain substances that can be used for therapeutic purposes of which are precursors for the synthesis of drugs. Diabetes mellitus is a group of metabolic alterations characterized by hyperglycemia resulting from defects in insulin secretion, action or both. It is projected to become one of the world's main disablers and killers within the next 25 years. Many factors contribute to the on-set of diabetes and these are termed as predisposing or risk factors. Environmental factors such as diet, obesity and sedentary life style increase the risk of diabetes. Other important risk factors include high family aggregation, insulin resistance, nutritional status, age and life style change due to urbanization. The management of diabetes is a global problem until now and successful treatment is not yet discovered. The present study is aimed to investigate the antidiabetic and antioxidant properties of extracts of different medicinal plants of Balochistan.

**Objectives:**

- To explore the antidiabetic and antioxidant potential of medicinal flora of Balochistan.
- To develop the low cost products of potential antidiabetic and antioxidant herbs.

**Present Status:**

- Medicinal plants are collected and prepared to get plant extracts by different extraction methods.

**Targets for 2019-20:**

- Antidiabetic activity of extracts by alpha amylase and glucose diffusion inhibition.
- Antioxidant activity of extracts.

**Title:** **Design and Fabrication of Low Cost Flash Point Equipment for Petroleum Products**

**Project Leader:** Mr. Muhammad Ajmal, EO

**Project Associates:** Mr. Mujeeb ur Rahman, CSO  
Mr. Khalid Hameed, JTO

**Duration:** 02 Years

**Year of Initiation:** 2018

**Background:**

Flash point is the lowest temperature at which a combustible liquid or solid produces sufficient vapour near its surface to generate an ignitable mixture with air. The flash point is a descriptive characteristic that is used to distinguish between flammable fuels, such as petrol, gasoline and combustible fuels like diesel. It is also used to characterize the fire hazards of fuels. The flash point is an empirical measurement rather than a fundamental physical parameter. The measured value will vary with equipment and test protocol variations, including temperature ramp rate (in automated testers), time allowed for the sample to equilibrate, sample volume and whether the sample is stirred. There are two basic types of flash points measurements that are open cup and closed cup. In the present work low cost, user friendly closed cup flash point apparatus for petroleum products will be developed with following specifications;

- Working temperature range from ambient to 300°C.
- Heating rate 5 to 6°C per min.
- Capacity of testing oil, 70 ml.
- Stirring rate 90 to 120 rpm.
- Ignition is electric.
- Heating device; continuously adjustable from 0 to 500 W.

**Objectives:**

- To design, fabricate and develop low cost user friendly, efficient flash point apparatus.

- To replace imported costly equipment.
- To ensure supply of equipment on cheaper rate.
- To promote scientific equipment manufacturing industry in the country.

**Present Status:**

- Designing and technical drawing of the flash point apparatus.
- Fabrication of sample cup, etc.
- Design and fabrication of the electronic circuitry.

**Targets for 2019-20:**

- Assembly of components and performance evaluation.
- Writing the technical report.

**Title:** **Development of Process for Leaching of Copper Minerals Using Regenerated Ferric Sulphate**

**Project Leader:** Mr. Mujeeb ur Rahman, CSO

**Project Associates:** Mr. Muhammad Ajmal, EO  
Mr. Muhammad Amir Raza, JSO

**Year of Initiation:** 2017

**Duration:** 03 Years

**Background:**

Balochistan possesses great unexplored potential of metallic and non-metallic minerals. Presently, the minerals being exploited are coal, copper, gold, silver, manganese, lead, chromite, barytes, sulphur, marble, iron ore, quartzite, limestone, sulphur, gypsum and calcite, etc. Copper ores generally occur in veins and grains disseminated through the host rocks and scales. The ores of copper mainly found in Balochistan are chalcopyrite, chalcocite, bornite and malachite. The prospective areas for these ores are Saindak, Rekodik, Amir Cha, Aamuri Chilghazi, Kirtaka, Nok Cha, Koh Marani, Patkok and Rabat. The most promising copper gold reserve is Rekodiq which holds about 5.9 billion tonnes of ore averaging 0.54% copper and 0.24 g/tonne gold with a value of \$ 500 billion, making it the fifth largest deposit of gold and copper. Rekodiq is a copper and gold mine in Chagai district of Balochistan province with a value up to \$500bn. The other

copper gold reserve is of Sandak i.e., about 400 billion tones of ore with an average 0.4 % copper and 0.3 g/tonne gold contents. Chalcopyrite,  $\text{CuFeS}_2$ , is the most abundant copper sulphide mineral, and efficient treatment methods for producing high quality copper from chalcopyrite concentrates have been in use for several decades. The conventional treatment processes are pyrometallurgical and involve smelting, which results in sulfur dioxide emissions, converting and electrorefining. Secondary copper sulphide minerals such as chalcocite ( $\text{Cu}_2\text{S}$ ) or covellite ( $\text{CuS}$ ), although not as abundant as chalcopyrite, represent a non-negligible source of copper. The enrichment zone of porphyry copper deposits or the sulphidic zones are examples of secondary copper minerals deposits. Acidified ferric sulphate is without a doubt the most common lixiviate for copper minerals and even under high temperature processing conditions, it is believed that oxidation by ferric remains the most favoured mechanism. In the proposed project the studies on recovery of copper from different copper ores of Balochistan and their concentrate will be undertaken.

**Objectives:**

- To develop low cost and environment friendly technology for utilization of huge deposits of Balochistan copper deposits.
- To utilize the indigenous ore deposits for the development of the country.
- To create job opportunities for the local inhabitants.

**Present Status:**

- Optimization of different parameters for copper leaching by ferric sulphate.

**Targets for 2019-20:**

- Optimization of ferric iron concentration and ratio to copper dissolution.
- Regeneration of ferric ions during copper leaching and its effects on efficiency of the process.



**Title:** Upgradation of Low Grade Manganese Ore of Lasbella District of Balochistan to Metallurgical Grade

**Project Leader:** Mr. Khurram Shehzad Buzdar, SO

**Project Associate:** Mr. Zaheer ud Din, SSO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Manganese is not found as a free element in nature; it is often found in minerals in combination with iron. Manganese is a metal with important industrial metal alloy uses, particularly in stainless steels. In earth's crust, the manganese content is 0.11%, which is the twelfth most abundant element. This concentration is very small as compared to aluminum=8.2%; iron=6.3% and titanium=0.66% but considerably higher than many commercial metals, like, copper=0.0068%; zinc=0.0079% and lead=0.001%. In Balochistan, manganese deposits are found in Lasbela district, Dhaddi, Khrrarri, Dhora, Gecheri Dhora, Gadani Ridge, Daddi Dora and Sanjru Dora. These places representing the southern part of the axial belt were investigated mineralogical for manganese. It has got big demand everywhere in the world. The consumption of manganese in Pakistan can be judged from the fact that millions of rupees per month are spent on the import of manganese from various parts of the world for the production of steel. Its importance can also be determined from the fact that it has no substitute in its applications. Manganese has an important contribution for the manufacturing of ferro-alloys and steel. It can also be used for the non-metallurgical purposes for the manufacturing of dry cell batteries, animal feed and plant fertilizers and therefore, has greater importance from industrial point of view. 30 percent of manganese is used during refinement of iron ore and 70 percent of manganese is used for steel alloy. Manganese is also used for production of colour glass.

**Objectives:**

- Upgradation of manganese ore for commercial use.
- To exploit the natural resources of the province.
- To develop cost effective process.
- To present and provide manganese ore for industry to reduce the import in term saving the steel foreign exchange.

**Present Status:** On-going

**Targets for 2019-20:**

- Collection of manganese ore from different areas of district.
- Crushing, grinding and sieving analysis.
- Preliminary chemical analysis of collected manganese.
- Trials for beneficiation of ore.
- Quality evaluation of beneficiated ore.
- Confirmation trials of lead ore beneficiation.

**Title:** **Preparation of Lead-Based Chemicals from Lead Ore of Balochistan**

**Project Leader:** Mr. Khurram Shehzad Buzdar, SO

**Project Associates:** Mr. Zaheer ud Din, SSO      Mr. Muhammad Amir Raza, JSO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

Lead is a soft, malleable poor metal and also considered to be one of the heavy metals. Lead is used in lead-acid batteries, bullets and shot, weights and is the part of solder, pewter, fusible alloys and radiation shields. There are some huge to medium mineable lead ore deposits reported by Geological Survey of Pakistan (GSP) in different districts of Balochistan like Chaghi, Khuzdar and Muslim Bagh. In Balochistan, major lead ore deposits are found in ophiolitic rocks especially in Khuzdar /Bella area. The Bella Ophiolite zone is the southern most exposure in a string of three major Ophiolitic occurrences in the axial fold thrust belt, which extends generally south and southwest from northern Pakistan to the Arabian sea. The ores found in these areas are Galena PbS and Anglesite PbSO<sub>4</sub>. The Galena ore contains associated metals i.e. copper and to some extent iron and gangue materials are silica, sulfur and alumina. The estimated reserves of Galena PbS in Balochistan are 60 million tons. The anglesite PbSO<sub>4</sub> is comprised of metal i.e. silver, copper and iron. The estimated reserves of anglesite ore in Balochistan are 65 million tons. Most ore contain less than 10% lead, and ores containing as little as 3% lead can be economically exploited. Ores are crushed, grinded and concentrated by gravity concentration and froth flotation typically to 70% or more. Sulfide ores are roasted, producing

primary lead oxide and a mixture sulfates and silicates of lead and other metals contained in the ore. For present project lead ore of Khuzdar district will be experimented.

**Objectives:**

- To encourage the industrialists for setting up of indigenous ore based chemical industry in Balochistan.
- Up-gradation and extraction of lead chemical on bench scale.
- The project would act as an incentive for setting up industry based on lead chemical.
- Development of low cost process and preparation of lead chemical.

**Present Status:**                      On-going

**Targets for 2019-20:**

- Trials for the preparation of lead-based chemicals.
- Quality evaluation of prepared chemicals.

## **PCSIR Laboratories, Hyderabad**

**Title:** Development of Dehydration Technique for Fruits and Vegetables.

**Project Leader:** Mr. Habibul Hassan Ghouri, EO

**Project Associates:** Mr. Muhammad Abdul Rehman, JEO  
Mr. Muhammad Yaqoob Kapri, JTO

**Year of Initiation:** 2018

**Duration:** 02 Years

### **Background:**

The agriculture sector is the main source of livelihood for the inhabitants of our country. The fruits and vegetables are produced in larger quantity. Due to unavailability of proper preservation facilities, the significant quantity of these products becomes spoil. These results are in reduction in pay back to the growers due to inadequate preservation / storage facilities and lacking market structure. The drying of products under the Sun is the traditional method to preserve the products. This system of drying is unprotected from sudden rainfall, dust, infestation by insects and interference of animals. Due to the loss of food quality there is decreases in revenue generation. To overcome this problem the Solar Dehydration Technology can be effectively used to protect the products to retain the quality, and to support in increases the revenue generation.

### **Objectives:**

- Development of preservation techniques/ treatment for shelf life of vegetables and fruits.
- To enhance the payback to the growers by value addition of products.

**Present Status:** On-going

### **Targets for 2019-20:**

- Study/ literature survey for appropriate methods of preservation is underway.
- Drying of different fruits and vegetables by using clean technology.
- Testing of different parameters after completion of drying process.

## **PCSIR Fuel Research Centre, Karachi**

**Title:** Synthesis of Furfural from Some Solid Waste Materials of Renewable Resources

**Project Leader:** Dr. Anila Sarwar, SSO

**Project Associates:** Mr. Syed Kabir Shah, SO Mr. Naseem Ahmed, SEO

**Year of Initiation:** 2018

**Duration:** 02 Years

### **Background:**

Furfural is a liquid chemical produced from the agricultural sources containing a hemicellulose component of pentosan. As no commercial synthetic routes have been found so far, the extraction of furfural from renewable sources is called green chemistry in the sense that production of a chemical is achieved with a biomass material. It becomes a high value product when extracted from a waste renewable source. The worldwide market for furfural is about 300,000 tonnes per year. The current market price for furfural is around US\$1,700 per tonne. The common applications of furfural are:

- Furfural is used as a selective organic solvent in refining of petroleum fuel, diesel fuel, lubricating oils, vegetable oils etc.
- Furfural is used to separate aromatics and retain paraffinic-type compounds from the mixture to improve the viscosity index, ignition characteristics, oxidation stability, colour, flash point and to lower the carbon forming tendency.
- It can also be used for the preparation of raw material for several resins.
- It is widely used in industries as a base material for synthesizing a family of derived solvents like furfuryl alcohol and tetrahydrofuran and in the production of resins for moulded plastic and metal coatings.
- It is used in the manufacture of insecticides.
- Furfural has been used in the food industry for flavoring purpose too.

### **Objectives:**

- To produce furfural from some renewable wastes.

- To develop stoichiometry between the raw materials of the feed to produce desired product, and to develop a control process for the synthesis reaction.
- To propose the best suitable renewable source and optimized parameters to get the highest yield of furfural.

**Present Status:**

- A process for the synthesis of furfural from rice husk is developed successfully.

**Targets for 2019-20**

- Reaction conditions for the synthesis of furfural from sugarcane bagasse and corncob will be optimized.
- Characterization study of the furfural will be carried out.
- On the basis of the highest percentage yield, the best method and reaction parameters for the production of furfural will be selected.

**Title:** **Remediation of Hazardous and Toxic Metals from Industrial Effluent Exploiting Waste Ash Residue of Oxidized Indigenous Coal Briquettes**

**Project Leader:** Mr. Syed Kabir Shah, SO

**Project Associates:** Dr. Anila Sarwar, SSO      Mr. Naseem Ahmed, SEO

**Year of Initiation:** 2018

**Duration:** 02 Years

**Background:**

The limitation of the availability of energy sources specially fuel oil and natural gas has become a serious threat for the society. The utilization of indigenous coal briquettes for energy source as the replacement of fuel oil is very profitable but on the other hand, will cause problem which is the ash residue of the oxidized product. This ash residue is a by-product of coal briquette and obtained after combustion reaction. Heavy metal industrial pollution is one of the most important environmental problems throughout the World. Some of these metals are classified as carcinogenic and can cause damage to the lungs, kidneys, liver and reproductive organs. Therefore, the removal of these heavy metals from industrial effluent exploiting low-cost adsorbent is a topic of major interest throughout the world.

**Objectives:**

- To explore the potential low-cost adsorbent for the removal of hazardous and toxic heavy metals from the industrial effluent.
- To investigate the efficacy of the ash residue derived by the complete oxidation reaction of indigenous coal briquettes as the remedy for the removal of heavy metals.
- To investigate different environmental factors on heavy metal remediation and the removal mechanism using spectroscopy.

**Present Status:**

- A process has been developed for the remediation of toxic and hazardous heavy metal.

**Targets for 2019-20:**

- Adsorption of chromium by coal briquette ash residue from textile industrial effluent.
- Comparison of the remediation method of the selected toxic metals by coal briquette with other reported methods.

**Title:** **Improving Soil Physio-Chemical Properties and Mitigation of the Harmful Effects of Soil Salinity by the Use of Low Grade Coal and Coal Derived Products.**

**Project Leader:** Mr. Amanat Ali, SO

**Project Associates:** Mr. Syed Kbair Shah, SO      Mr. Nadir Buksh, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

Soil salinity is a major problem, reducing the yield of wide variety of crops in our country. Worldwide approximately 5% of the arable land is adversely affected by high salt concentration. The salinization and alkalisation induce upon soil certain chemical and physical characters, which might have a profound effect on the agro-ecosystem. The excess exchangeable sodium (Na) and the high soil pH, as a result of salt accumulation, cause deformation of soil structure and decrease in hydraulic conductivity and infiltration rate of soil.

**Objectives:**

- To investigate the role of indigenous coal derived HA (humic acid) in order to mitigate soil salinity and improving soil physio-chemical properties.
- To establish the correlation between the dose of humic acid and soil total dissolved salts (TDS), excess of exchangeable sodium and to reduce the soil pH.

**Present Status:** New project.

**Targets for 2019-20:**

- Field survey.
- Sample collection and its analysis before field trials.
- Lab scale / field trials.
- Sample collection and its analysis after field trials.
- Data collection and compilation of lab scale trial.

**Title:** **To Study the Multifunctional Activities and Sundry Uses of Humic Acids from Pakistani Coals.**

**Project Leader:** Dr. Zakiuddin Ahmed, SSO

**Project Associates:** Dr. Shehnaz Dawar (Director, NNRC, University of Karachi)  
Dr. Shahina Fayyaz (NNRC, University of Karachi)  
Mr. Nadir Buksh, SO

**Year of Initiation:** 2019

**Duration:** 02 Years

**Background:**

As coal is mostly lignite and there is an urgent need to produce electricity. It would consequently increase the release of toxic gases including hazardous volatiles and acid rain producing elements. It will be the big reason for environmental pollution in the surrounding areas and hence a pretreatment is very necessary to remove humic acid (HA) isolated from coals. This is complexed organic macro-molecules with acid functional groups, primarily carboxylic acids and phenols as well as carboxyls, amines, aromatic and aliphatic carbons. Humic acid binds heavy metals due to its higher content of oxygen containing functional groups, which can



form stable complexes with metals like Cu, Hg, Cd, Cr, etc. The binding capacity has been demonstrated in several studies. It is found that humic substance can reduce the concentration of free metal ions in waters. The binding capacity of humic acids is dependent on the pH and the concentration of humic acids used. The resultant metal humic acids complex is non-toxic and can be utilized in agriculture and industry. As humic acids have higher metal binding capacities than most commercial ion exchangers and they selectively bind, store and release metals, so they can be substituted for more expensive, organic and inorganic absorbents for detoxification.

**Objectives:**

- Proper and batch wise monitoring of functional groups maintaining quality of native coal.
- Feasible and environmental friendly coal products with valuable by-products, beneficial for uses in the field of poultry, veterinary, fish farming, waste water treatment, as fertilizer support and plant growth hormone, as mycotoxins detoxifier, positive/negative effects on nematodes and in pharmaceuticals for disease resistance as well.
- Preparation of more effective formulations for increasing agriculture yield.
- Industrial utilization in pollution control and sustainability of the environment.

**Present Status:**

- The related work done earlier has been consolidated in the project as a feed back.
- R&D product provided to farmers found good for growth of crops and ready for commercialization.
- R&D product for poultry has also been used and found perfect on one batch and further repetition is necessary for final confirmation.
- Trial for positive and negative effects on nematodes is partially monitored at NNRC University of Karachi and further is continued
- Publicity of the benefits and commercialization of developed products is under way.
- Under waste water treatment, R&D product for the treatment of industrial effluents from tanneries is also ready for commercialization.

**Targets for 2019-20:**

- Data collection and compilation of trials and treatments.
- Field survey.
- Procurement of standards and other chemicals.
- To produce environmental friendly products further.
- Compilation of results for patents and publications.

**Title:** **Development and Characterization of Nano-cellulose Gasoline Hybrid Fuel**

**Project Leader:** Mr. Syed Burhanuddin Abdali, PSO

**Project Associates:** Dr. Zakiuddin Ahmed, SSO Dr. Anila Sarwar, SSO  
Mr. Naseem Ahmed, SEO Mr. Syed Kabir Shah, SO  
Mr. Nadir Buksh, SO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Biomass has been extensively studied and utilized as a reliable, green, and renewable energy sources in recent years. To use the biomass as an effective energy source, most of the efforts have been focused on the conversion of biomass into liquid fuel (i.e. ethanol). Several biomass materials such as wheat, corn, and sugar cane, which are competing with the food supply chain has been extensively exploited for the conversion of biomass into liquid fuels. Biomass cellulosic materials with at least one dimension in the nanometer range are referred to as nano-cellulose. Generally, nano-cellulose materials are subdivided into three categories: bacterial nano-cellulose (BNC), cellulose nano-fibrils (CNFs), and cellulose nanocrystals (CNC). The production of the three types of nano-cellulose materials takes place in different ways; BNC is produced bio-technologically by bacteria, CNFs are mechanically produced by delaminating plant based cellulose and CNCs are isolated by chemical hydrolysis or oxidation. The present research proposal offers a new approach for the utilization of biomass as an effective nano-energy source. The biomass to be used is cellulosic biomass originating from any kind of biomass such as wood chips, forestry residues, switch grass, etc. The nano-cellulose particles from the biomass material will be isolated and directly mixed with gasoline to form a stable hybrid fuel. So, there is no need to convert the biomass into liquid fuel. The combination of unique features of nano-cellulose, such as hydrophilic surface chemistry and high specific surface area, makes it a very promising material for fuel processing technology.

**Objectives:**

- Isolation of nano-biomaterial from the cellulosic biomass originating from agricultural and forest origin for non-food applications and its characterization as a high value-added

product in the field of fuel and energy

- Development of a process for the fabrication of nano-cellulose gasoline mixture as a potential fuel to be directly used in internal combustion engines.

**Present Status:** New project

**Targets for 2019-20:**

- Isolation of nano-cellulose material from cellulosic biomass.
- Surface characterization of nano-cellulose material using Scanned Electron Microscopy (SEM), X-ray Diffraction (XRD), and Fourier Transform Infrared (FTIR) techniques.
- Optimization of the parameters for the fabrication of nano-cellulose-gasoline hybrid fuel.
- Physico-chemical properties of the fabricated fuel such as viscosity, cloud point, pour point, flash point etc.
- Combustion characterization of the nanocellulose based hybrid fuel using Thermo Gravimetric Analyzer and isoperibol bomb calorimeter.

**Title:** To Develop the Technology for the Production of Solar-Hydrogen Fuel

**Project Leader:** Mr. Syed Burhanuddin Abdali, PSO

**Project Associates:** Dr. Gul-e-Rana, SSO                      Mr. Santosh Kumar, SSO  
Mr. Amanat Ali, SO                                      Engr: Ali Gohar, JE

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Solar hydrogen energy is an energy cycle where a solar powered electrolyzer is used to convert water / dilute electrolytes to hydrogen and oxygen. Hydrogen and oxygen produced thus are stored to be used by a fuel cell to produce electricity when no sun light is available. Hydrogen is a renewable source without hazardous by products. More importantly hydrogen is a source regenerating fuel; It can be produced from water, immediately stored and finally used in either internal combustion or fuel cells to burn back to water. It will be energy efficient with the advantage of storing hydrogen reversibly in solid state materials e.g. metal hydrides, carbon nano

-tubes, polymers and chemicals complexes. Primary data in literature show that 23 V max and 3A max current are enough to produce hydrogen. Hydrogen gas has the highest calorific value of 150 kJ/g among all fuels or 51628 Btu/Lb. Hydrogen power station can be considered with the construction of worth of Rs.10.00 billion (€50 M) for production of 16 MW

**Objectives:**

- To purchase solar panels and electrolysis system.
- Assemble of solar, hydrogen fuel system.
- To generate secondary data and compilation of report.
- Preparation of techno economic feasibility report for solar hydrogen fuel technology.

**Present Status:**                      New project

**Target for 2019-20:**

- To developed technology for solar hydrogen fuel.

## **Leather Research Centre, Karachi**

**Title:** Cost Efficient Nano-Adsorbent Material to Remove Colourants from Tannery Wastewater: Synthesis and Application

**Project Leader:** Ms. Tahira Ayaz, SSO

**Project Associates:** Dr. M. Kashif Pervez, PSO Ms. Sarwat J. Mahboob, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

### **Background:**

There has been a high increase in production and utilization of dyes in last few decades resulting in a big threat of pollution. Reactive dyes are commonly used in textile and leather industries. Some of the reactive dyes possess poor binding ability on substrate surface and it is discharged in industrial effluents. The adsorbents used for reactive dyes removal include activated carbon but due to its poor adsorption effectiveness, long equilibrium time and anionic nature of reactive dyes, the surface of activated carbon needs some chemical pre-treatments. Other adsorbents reported require either tedious preparation steps, toxic chemicals for synthesis or longer adsorption process times; hence search of a highly efficient, easily available, low cost, sustainable and environmentally friendly adsorbent is still a demanding issue. It is valuable noting that the removal of dyes can be done by various techniques; however, there exists no such methodology which can successfully remove all types of dyes at low cost. Use of carbon can sometimes be restricted due to economic considerations. Besides this, the regeneration is expensive and involves adsorbent loss as well as efficiency. Recently, the consumption of nano-material is of interest as adsorbents due to their superior advantages for wastewater applications. Thus, nano-fiber adsorbents when compared to traditional adsorbents such as activated carbons offer advantages such as lower sample loss, easy separation without filtration, faster and higher adsorption efficiency. Therefore, we have emphases to develop such material. The industry faces the green pressure (e.g. zero discharge of hazardous chemicals (ZDHC) & REACH) of having to use new methods of manufacturing which are environmental friendly for the company to remain competitive on the market and also to be a world class manufacturing organization-environmental legislation obliges industries to eliminate colour from their dye-containing effluents, before disposal into water bodies. The leather & textile industry consumes a large

amount of water in its manufacturing processes used mainly in the dyeing and finishing operations. The wastewater from both industries is classified as the most polluting of all the industrial sectors, considering the volume generated as well as the effluent composition. Additionally, the increased demand for textile products and the proportional increase in their production and the use of synthetic dyes have together contributed to dye wastewater becoming one of the substantial sources of severe pollution problems in current times.

**Objectives:**

- To improve the dye removal efficiencies/ adsorption capacities.
- To dispose off the spent adsorbents in an environmental friendly way.
- To develop low cost nano adsorbents as compared to readily available carbon activated adsorbents.

**Present Status:**

- Work is in progress for the synthesis of nano-adsorbent material.
- Dye removed after it passes through the adsorbent (column chromatography technique used).
- New routes found for the removal of colourants.

**Targets for 2019-20:**

- To synthesize low cost and most effective adsorbent.
- To perform dye removal experiments on laboratory scale and to check the effectiveness properties of the adsorbent.
- To make the adsorbent more efficient and easy to use.

**Title:** Eco-Friendly Dyeing of Leather and Fabrics with Seaweeds

**Project Leader:** Dr. M. Kashif Pervez, PSO

**Project Associates:** Dr. Sarwat Ismael, PSO      Dr. Raj Kumar Dewani, PSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Natural dye is an important dyeing method and has a long history. It plays an important role in the textile and leather industry nowadays. The use of the cut parts from the tree, the leaves or the floral waste from the flower shop can also be used as good dyestuffs. The use of these plants for dyeing is economic and environmental friendly. The chemical dyes have been largely used all over the world but the demand for natural (organic) dyes garments or products are increasing. This means that the development of natural dye is an important issue for making it becomes more user friendly for dyeing industry or small dyeing house. The use of different mordant and pH can help to produce more colour range with unlimited colour. Some substantive dyes can provide a strong colour without using mordant. This study will explore suitable technique for more efficient natural dyeing using suitable bio-mordant to improve the colour fastness of natural dyes on fabric and leather. Similarly these bio-mordant based colors will also replace toxic food grade dyes in this way natural dye will attract the worldwide attention again. For this proposal LRC Scientists already established collaboration with University of Karachi (Human Resource) and with Masood Textile Mills Faisal Abad (Textile samples and fastness studies). Environmental legislation obliges industries to eliminate color from their dye-containing effluents, before disposal into water bodies. The leather and textile industry consumes a large amount of water in its manufacturing processes used mainly in the dyeing and finishing operations. The wastewater from both industries is classified as the most polluting of all the industrial sectors, considering the volume generated as well as the effluent composition. Additionally, the increased demand for textile products and the proportional increase in their production, as well as the use of synthetic dyes have together contributed to dye wastewater becoming one of the substantial sources of severe pollution problems in current times.

**Objectives:**

- To extract natural colorants from seaweeds, their characterization and fixing to fabrics and leather.

- To discover new economically and environmentally friendly dyes which replace mutagenic aromatic amines based dyes.
- Greener alternative to satisfy the consumers' growing demand of eco-friendly products.

**Present Status:**

- Brown seaweeds applied on cotton fabric as an eco-dye.
- Green seaweed as a source of bio-fixing agent is applied on cotton.
- Bio-fixing agents from green seaweed enhance in dye exhaustion as well as antimicrobial potential of dyed fabric.
- The antimicrobial potential of dyed fabric has higher effectiveness than commercial anti-fungal agents.
- Bi-combination of phenolic and metallic mordants using brown seaweed colourants also enhancing the dye-exhaustion, anti-microbial potential and develop different hues on cotton fabric.

**Targets for 2019-20:**

- Colours extract from natural sources e.g seaweeds.
- Pre and post studies of the natural colours.
- Application on textiles.
- Natural colors use as a bio-mordant.
- Antimicrobial studies of the natural colourants and applied fabrics.



**Title:** **Synthesis of Rare Earth Metals (REM) Based Pigments for Leather Surface Dyeing**

**Project Leader:** Dr. M. Kashif Pervez, PSO

**Project Associates:** Ms. Tahira Ayaz, SSO      Ms. Sarwat J. Mahboob, SSO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

The list of problems currently affecting leather finishing industry includes the bans on usage of heavy metal ions like chromium, lead, cobalt and nickel in the pigment coat, alkyl tin compounds, alkylphenol ethoxylates, N-methyl pyrrolidone, formaldehyde and other hazardous cross-linkers in the finish formulation. The problems associated with the colorants are not specific to the leather industry alone. Plastic and ceramic colourants based on several metal ions are today being phased out. It is with this background that relook into the pigments used for coloring not just leather but several products has become essential. Pigments have undergone several changes with time. Naturally occurring pigments such as ochres and iron oxides were used in pre-historic times, alongside several pigments from plant bodies. In recent years the environmental and toxicological concerns arising from the use of pigments based on chromium (VI), cadmium, lead, mercury etc has forced pigment industry to look at environmentally benign alternatives. While, high performance organic coatings have been employed in several industries, the pigments derived from rare earths have shown promise owing to their characteristic intense colour due to charge transfer interactions between a donor and an acceptor with metal ion. Textile and leather products are the leading exports from Pakistan. These industries consume bulk of hazardous chemicals with discharge of massive volume of contaminated effluent. Dyeing is essential part of leather processing. REACH, a European Regulation calls for products that are free of banned amines. In the present study, synthetic pigments will be developed without the use of banned aromatic amines.

**Objectives:**

- To prepare a safe synthetic metal complex coloring agent that does not produce toxic effects.

- To develop green chemical concept in compliance with REACH program.
- To substitute the commercially available hazardous azo colorants by non-toxic green chemicals in leather making.
- To enhance penetration effectiveness of leather surface dyes.
- Application of rare earth metal complexed dyes on natural fibres e.g. leather, cotton textile, wool etc.
- Study the various fastnesses and strengthen properties of the applied matrixes.

**Present Status:**

Following processes have been developed for the synthesis of dyes and their metal complexes:

- Reddish orange dyestuff for leather and textile Industry.
- Yellowish orange dyestuff for leather and textile.
- Active methelene based pigments.
- Iron complexed dye.

**Targets for 2019-20:**

- Synthesis of dye as a legend.
- Metal complex formation.
- To check the colourant properties of the dye (ligand).
- To check the colourant properties of the metal complexed dye.
- Spectroscopic analysis of pre-metalized dye and metalized dyes.
- Application of dyes on natural and artificial fibers and analysis of the applied matrixes.

**Title:** **Development of Eco-Friendly Leather Conditioner by Utilizing Indigenous Resources**

**Project Leader:** Dr. Beena Zehra, SSO

**Project Associate:** Mr. Raja Asad, ST

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

The liquid leather protecting products to clean the leather goods surfaces and to repel water and protect against stiffening and cracking (may be darken also with time) are being highly demanded and imported from different countries. These leather conditioners are based on various toxic chemicals e.g aromatic chemicals like butylated hydroxytoluene, polyols such as sorbitol and other polymers like polyurethane, etc. The daily use of leather items is being increased rapidly due to the flexibility and strength of leather. Therefore, leather made articles such as leather shoe require proper conditioning agent to maintain its physical characteristics. Thus, new environmentally friendly technologies leading to new products of high value are required to be adopted.

**Objectives:**

- Development of technology for the utilization of non-toxic indigenous raw material.
- Conversion of non-toxic resources into eco-friendly leather conditioner.

**Present Status:**

- Preliminary experiments have been carried out.
- Different leather conditioners have been prepared from natural resources at lab scale.
- Comparison with market available products has been carried out.

**Targets for 2019-20:**

- Preparation of leather conditioner in sufficient quantity for marketing.
- Application and evaluation of leather conditioner.
- Publication.

**Title:** Development of Zero Finishing Chemicals Technology for High Performance Gloving Leather

**Project Leader:** Dr. Beena Zehra, SSO

**Project Associate:** Mr. Raja Asad, Sr. Technician

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

The high quality gloving leather is used for protection of hands from chemical /mechanical risks (injuries) and highly demanded by exporters and Industrialists. The finishing of these gloving leather is being carried out using disperse systems containing as auxiliaries: pigments, binders, natural and synthetic waxes, preservatives, plasticizers, thickeners, fillers, odorizers, penetrating agents, solvents. Finishing is carried out by a number of technologies that impart different characteristics. Current problems of the leather finishing industry include omission of heavy metal salts (chromium, cadmium, lead, cobalt, mercury, nickel) from pigment pastes, ethoxylated alkyl phenols from wax dispersing agents, formaldehyde and others from toxic cross linking agents. Environmental toxicity concerns have lead to new alternatives for finishing in tanneries. Therefore, this project is emphasized to develop zero finishing chemicals technology through supplementary process during leather processing in tannery. The process will benefit the reduction of cost of finishing, labour, mechanical operations and also energy consumption.

**Objectives:**

- Production of gloving leather through reduction of finishing process.
- Optimization of developed technology.

**Present Status:**

- Investigation of raw material and literature survey has been completed.
- Reduction of finishing process has been optimized after 03 skin processing.
- Provisional patent has been submitted to Pakistan Patent Office.

**Targets for 2019-20:**

- Data would be arranged for publications and patents.
- Physical and chemical testing would be performed.
- Technology would be commercialized.

**Title:** **Development of Process for the Conversion of Tannery Sludge into Value-Added and Eco-Friendly Products.**

**Project Leader:** Dr. Hafiz Rub Nawaz, PSO

**Project Associates:** Dr. Beena Zehra, SSO      Mr. Barkat Ali Solangi, SSO  
Ms. Uzma Nadeem, SEO

**Year of Initiation:** 2019

**Duration:** 01 Year

**Background:**

Leather is the third largest foreign exchange earning sector of Pakistan through export. But since consecutive last five years, the export of leather is decreasing continuously. The main reason behind this is the failure of compliances with international restrictions regarding hazards chemicals and environmental managements. To fulfill international requirement Pakistan is going to set effluent treatment plants in tannery sectors of Sialkot and Karachi. However after aerobic treatment, the main issue is the disposition of toxic sludge. To overcome this problem this project is desired to analyze sludge composition and then covert it into appropriate value added products for safe utilization of tannery wastes.

**Objectives:**

- Identification and evaluation of toxins in tannery waste.
- Safe utilization of tannery sludge, as appropriate products through a feasible process/ technology.

**Present Status:** New Project

**Targets for 2019-20:**

- Characterization and pre-treatment of tannery sludge.
- Safe process for tannery sludge utilization.

## **PCSIR Laboratories, Skardu**

**Title:** Utilization of Russian Olive (*Elaeagnus angustifolia*) in the Preparation of Different Food Products

**Project Leader:** Mr. Faizullah Khan, SO

**Project Associate:** Mr. Tariq Umar Khan, PSO

**Year of Initiation:** 2016

**Duration:** 04 Years

### **Background:**

Russian olive (*Elaeagnus angustifolia*) belongs to family Elaeagnaceae (Oleaster). It is a deciduous tree, flowers in June and the fruit ripen from September to October. The fruit is oval with a large seed just like olive fruit. The pulpy portion of fruit becomes dry powder in fully ripe fruit. The fruit is used as food. Russian olive is one of the widely consumed medicinal plants throughout the world. The fruit of Russian olive is very rich source of vitamins and minerals, especially in vitamins A, C, E, flavonoids and other bio-active compounds. It is also a good source of essential fatty acids, which is fairly unusual for a fruit. Fruits, leaves, and flowers of oleaster are used in the nausea, vomiting, jaundice, asthma, rheumatoid arthritis and tetanus in folk medicine. Previous studies demonstrated muscle relaxant activity, antibacterial and antinociceptive effects of *Elaeagnus angustifolia*, antioxidant properties of this species are also common. It is being investigated as a food that is capable of reducing the incidence of cancer and also as a means of halting or reversing the growth of cancers. Russian olive is an unidentified natural resource of Pakistan (Gilgit-Baltistan) which has food, medicinal and economical importance. The nutritional data (physico-chemical, phytochemical and bioactive compounds) of Russian olive of our country have not been previously reported. The aim of this research work is to explore this unidentified natural resource, nutritionally evaluate and develop as well as formulate value added food products from this natural resource of the country.

### **Objectives:**

- To explore this unidentified natural resource, nutritionally evaluate and develop and formulate value added food products.
- Preparation of therapeutic (used as food as well as medicine) value added products from Russian Olive.

**Present Status:** On-going

**Targets for 2019-20:**

- Two new processes will be developed i.e
  - 1) Powder for drink.
  - 2) Russian olive energy bar.
- Brusher on Russian olive will be printed.
- Compilation of research data for publication.
- Submission of patent of two already developed products.



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