***Extraction of antimicrobial metabolite***

Antimicrobial metabolite was extracted from active strains, *Streptomyces roseochromogenus* TSR12 in ethyl acetate. Extracted metabolite was subjected to the fractionation and purified by preparative TLC (hexane and ethyl acetate, 1:1). Three fractions were collected ($R_f$ values were 0.32, 0.64 and 0.96), and the two fractions having $R_f$ value 0.32 and 0.96 exhibited antimicrobial activity. Further purification and chemical profiling of the bioactive compound(s) is in progress.

***Selection of efficient antimicrobial strain***

Phylogenetic analysis based on 16S rDNA sequence revealed the taxonomic affiliation of the 33 strains with the different species of *Streptomyces*. Six strains were further evaluated for the nature of their antifungal component. Proteinaceous nature of the compound was confirmed after temperature and enzymatic deactivation of the active fraction. It revealed the *Streptomyces* strains harbouring family 18 chitinolytic systems responsible for the antifungal activity.

Using molecular methods of nucleotide sequencing (figure below) [GenBank Accession no: JQ321838, JQ320491-JQ320495 (protein_id: AFH01027-AFH01031)] and quantitative real time RT-PCR assays (Figure below) most potent active strain was determined by characterizing the nucleotide sequence of the enzymes active domain along with phylogenetic approach for genetic relatedness. Further purification and detailed characterization will be required for process optimization of the enzymes.

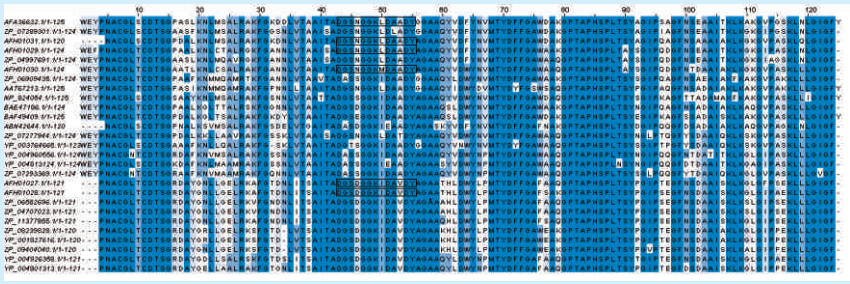


*Fig.: Clustal W alignment of the catalytic domain peptide sequences from six strains with significant NCBI blast matches.*

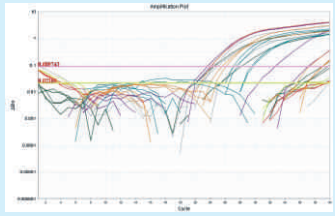


*Fig.: Amplification plot for comparative real time RT-PCR analysis of the chitinase genes from six potential Streptomyces strains for their chitinase expression profile.*

**GPP**

**Screening and molecular characterization of microbial pathogen diversity of *Staphylococci* and development of diagnostic test for rapid detection**

**PI & Members:**

Dr Tarun Chandra Bora PI
Dr BS Bhau CoPI
Dr SB Wann CoPI

DBT- Twining project, New Delhi

**Objectives:**

- ✓ Survey, screening and isolation of strains of *Staphylococcus* species from different niches of soil, food sources, hospital and clinical samples and maintain the cultures.
- ✓ Characterization of cell surface proteome of *Staphylococcus* strains and production of high quality antibodies.
- ✓ Development of microbial genotyping methods for strains of *Staphylococcus* species based upon small sets of polymorphism selected from known genomic diversity on the basis of their optimal combinatorial informative power.
- ✓ Develop diagnostic test to identify infections with these virulent *Staphylococcus* strains for clinical isolates of other *Staphylococcus* strains.

**GPP**

**A study on Taxonomy and Ethnobotany with an emphasis to biochemical parameters of the family Myristicaceae R. Br. In North East India**

**PI & Members :**
Dr Dipanwita Banik PI

**Funding Agency :**
Science and Engineering Research Board, (SERB), DST, Govt. of India

**Objectives:**

- ✓ A checklist of the family *Myristicaceae* in North East India will be made in consultation with deposited types and other specimens in different national, regional herbaria and relevant protologues.
- ✓ Extensive field tours will be undertaken to collect fresh specimen and record data of distribution, variation, phenology, ethnobotany.
- ✓ The ethnobotanical information will be collected and collated for utilization of the species from primary and secondary sources.
- ✓ The circumscription of different taxa will be made based on protologues, types and assembled specimens from international, national and regional herbaria whenever necessary and their identification will be confirmed and nomenclature will be updated.
- ✓ For species full nomenclatural citation including those of synonyms, types, detailed description, distribution, phenology, ecological notes, vernacular names, economic uses, specimens examined, illustration, photographs and distribution maps will be given and user friendly taxonomic identification key will be prepared.
- ✓ The herbarium sheets will be deposited to National/Regional herbaria.
- ✓ The content of fixed oil, flavonoids, amino acids etc. will be screened from various plant parts of different species through standard procedures to check its correlation with taxonomy.

**Significant Achievements**:

The identification of different species in this family *Myristicaceae* R. Br. is very difficult because of dioecious trees, lesser number of female flowers compared to male flowers, more or less similar shape and texture of leaves. Economically this family is very important for valuable nutmeg from *Myristica fragrans*, two oils from the seeds of *Myristica fragrans*, the essential oil and fixed oil. Essential oil is used as carminative and flavouring agent. The fixed oil is used as mild stimulant for external application and in the manufacture of perfumes. The mace and aril is very aromatic and used as a spice. This family was also treated discretely and with confusion in several regional Floras viz., Flora of Tripura (Deb, 1981), Flora of Jowai and its vicinity, Meghalaya (Balakrishnan, 1983), Contributions to the Flora of Namdapha, Arunachal Pradesh (Chauhan, 1996), Trees of Duars (Rao, 1957), Flora of Majuli (Islam, 1990). Therefore it became essential to undertake the study of taxonomy of the family *Myristicaceae* for its correct identification, update the nomenclature and provide correct classification and to bring together all information pertaining to taxonomy and ethnobotany of the family in North Eastern India.

Therefore, the following literature were consulted viz., earlier Revisionary Works of JD Hooker (1886); King (1891); Warburgh (1897), Sinclair (1958; 1961; 1968;1975), de Wilde (1979; 1984; 1985; 1997; 2000), Regional Floras viz., Fl. Br. India, Fl. Assam, Fl. Tripura, Forest Fl. Meghalaya, Fl. Jowai, Fl. Majuli, Fl. Bhutan, Fl. Nepal, Fl. China etc., Index Kewensis, Wall. Cat., websites like The Plant List, IPNI etc. The following herbaria were consulted viz., Central National Herbarium, Howrah, Kolkata [CAL], Eastern Circle of Botanical Survey of India, Shillong [ASSAM], Jawaharlal Nehru Tropical Botanical Garden Research Institute, Palode, Trivandrum,

Kerala [JNTBGRI], Forest Herbarium, Bangkok [BKF]. A tentative checklist with synonyms and type specimens comprising 8 species under 3 genera of the family Myristicaceae distributed in North East India was prepared.

Field survey was undertaken in various parts of Meghalaya and Assam. Male plant of *Horsfieldia amygdalina* (Wall.) Warb. from Quinine village, Meghalaya, female plant of *Horsfieldia kingii* (Hook.f.) Warb. and male plant of *Knema erratica* (Hook.f. & Thoms.) Sinclair from Deopahar, Golaghat District and male plant of *Knema linifolia* (Roxb.) Warb. from Tilikiam Bezgaon, Jorhat district, Assam were collected. The phenological and ehnobotanical primary data were documented through photography and video and the collected specimens were dried and poisoned with 6% $HgCl_2$ Solution and processed for preparation of herbarium. The collected specimens were studied with stereomicroscope for various vegetative and reproductive morphological characters. The measurements were taken of various parts and Botanical illustrations were made. The ethnobotanical data *Horsfieldia amygdalina* (Wall.) Warb. and *Horsfieldia kingii* (Hook.f.) Warb. were collected and collated from both primary and secondary sources. Various plant parts collected are dried and powdered and preserved for phytochemical screening. The dried specimens like aril and leaves of *Horsfieldia kingii* were extracted with various polar and non polar solvents in Soxhlet apparatus and the process of extraction is being standardized.

*Fig.: Horsfieldia kingii (Tree)*

*Fig.: Horsfieldia kingii (Fruit)*

*Fig.: Horsfieldia kingii (L.S. of Fruit)*

*Fig.: Horsfieldia kingii (Twig)*

**GPP**

**DNA Fingerprinting of Endophytic Actinomycetes Isolated protected Forest Areas of Assam and Mizoram**

**PI & Members :**

| | |
|---|---|
| Dr Ratul Saikia | PI |
| Dr TC Bora | Co-PI |

**Funding Agency:**
DBT, New Delhi

**Objectives :**

- ✓ Genetic diversity of endophytic actinomycetes
- ✓ Bioprofiling of endophytic actinomycetes
- ✓ DNA Barcoding of biologically active strain(s).

**Significant Achievements:**

***Isolation of Actinomycetes.*** We have collected some medicinally and economically important plant species from protected forest areas like *Kaziranga National Park, Gibbon Wild Life Sanctuary* and *Dibru Saikhuwa Reserve Forest*. We have isolated more than 200 strains of endophytic actinomycetes (Fig. 2). The actinomycetes strains were observed under compound microscope for their acid fastness and gram staining properties. It

has been found that all the actinomycetes are gram positive. The morphological characters of their colony have been recorded.

***Screening for antimicrobial and enzyme activities.*** From the isolated endophytic actinomycetes strains most of them were screened for their activities against some test pathogens (fungi and bacteria). Among them fungal pathogens are *viz. Candida albicans* MTCC3017, *Fusarium oxysporum f. sp. ciceri* NCIM1281, *Aspergillus niger* and *Rhizoctonia solani* and bacterial strains are *viz. Staphylococcus aureus* MTCC96, *E. coli* MTCC739 and *Pseudomonas aeruginosa* MTCC2458. On the other hand the activities for production of different enzymes *viz.* lipase, amylase and cellulase were done in specific media prepared according to protocol provided.

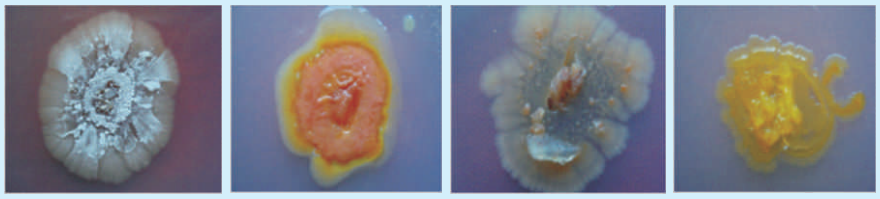


*Fig. Few actinomycetes strains*

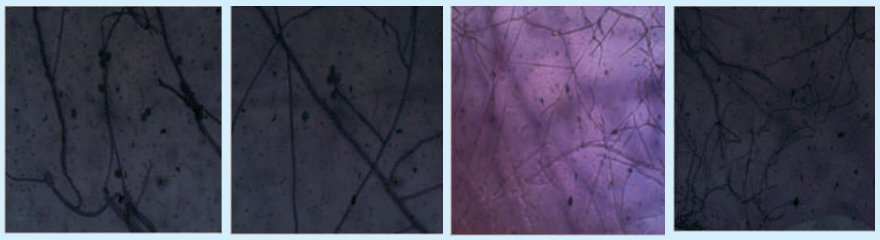


*Fig. Microscopic view of few endophytic actinomycetes*

***16S rDNA amplification and sequencing for active strains.*** 16S rDNA were sequenced for identification and the sequences were submitted to NCBI GenBank. Accession numbers of the submitted sequence are from KF021238 to KF021245 and some of the identified strains are like *Streptomyces mutabilis, S. kunmingensis, S. herbaricolor, Isoptericola variabilis, S. racemocchromogenes* and *S. polychromogenes*.

| GPP | **Detoxification of mustard seed based product through fermentation process based on North East traditional practices and their value addition.** |
|---|---|
| **PI & Members:**<br>Dr T C Bora — PI<br>Dr M Khongsai — Co-PI | **Objectives :**<br>✓ Microbial detoxification of glucosinolates and their degradation products for improving protein quality and availability, whilst removing the antinutritional compounds. Sinigrin (2-propenyl-glucosinolate) will be used as a model for isolation of microbial degraders of glucosinolates due to availability, solubility and easy measurement.<br>✓ Documentation of the traditional fermented food products. |

## Chemical Sciences

| MLP | **Green approaches toward development and value addition of bioactives & biopolymers** |
|---|---|
| **Funding Agency:**<br>CSIR, New Delhi | |

Development of analogues of novel bioactive molecules

**PI & Members:**

Dr Dipak Prajapati PI

Member
Dr Romesh Ch Boruah
Dr PJ Bhuyan
Dr HN Borah
Mr KC Lekhok
Dr Pranjal Gogoi
Dr Sanjeev Gogoi

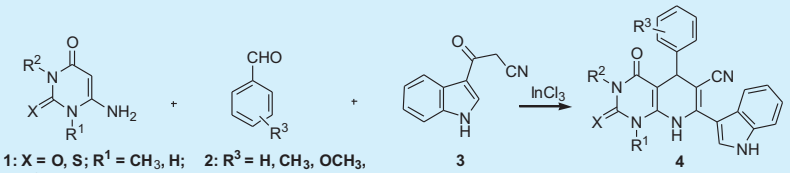
**Objectives:**

- ✓ Synthesis of analogues of antiviral, antibacterial and antitumor agents, anti gastric ulcer agents.
- ✓ New molecular entities for diverse biological activity.
- ✓ Assay for potential biological activity of the new synthetic molecules.
- ✓ Developments sustainable organic reactions.

**Significant Achievements:**

**Multi-component reactions for the synthesis of dihydropyrido[2,3-*d*]pyrimidine derivatives 4**

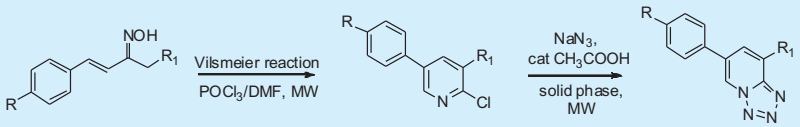
Some novel functionalized dihydropyrido[2,3-*d*]pyrimidine derivatives 4 were synthesized using a one-pot three-component reaction of 6-aminouracils 1, aryl aldehydes 2 and 3-cyanoacetyl indole 3 using $InCl_3$ as catalyst (Scheme 3).




Scheme 3

**Microwave promoted rapid and convenient synthesis of 3,5-disubstituted 2-chloropyridines and their conversion to tetrazolo[1,5-*a*]pyridines**

A fast, convenient and high yielding method for the synthesis of new 3,5-disubstituted 2-chloropyridines *via* the Vilsmeier reaction of various *α*,*β*-unsaturated ketoximes under microwave irradiation was developed. Due to the hazardous/toxic solvent free condition and the use of microwave energy, this method can be considered as an green and environmentally benign protocol for the synthesis of 3,5-disubstituted 2-chloropyridines. These newly synthesized compounds were converted to the corresponding tetrazolo[1,5-*a*]pyridines by microwave mediated solid phase reaction in presence of acid catalyst in moderate to good yields.

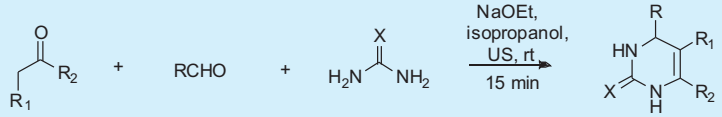



3,5-Disubstituted 2-chloropyridines

Tetrazolo[1,5-*a*]pyridines

**Facile ultrasound-assisted synthesis of 3,4-dihydropyrimidin-2(1*H*)-one/thione fused steroidal derivatives by a three-component reaction**

An ultrasound assisted, simple, fast and efficient base-catalyzed one-pot reaction for the annulation of 3, 4-dihydropyrimidin-2(1*H*)-one/thione moiety to A-, B- and D- ring of steroids using three-component reaction of steroidal ketones, aromatic/aliphatic aldehydes and urea/thiourea was developed. This methodology provides a new preparation of A-, B- and D-ring fused steroidal 3,4-dihydropyrimidin-2(1*H*)-ones/thiones in high yields after short reaction times under mild conditions.




Dihydropyrimidin fused steroidal/nonsteroidal derivatives

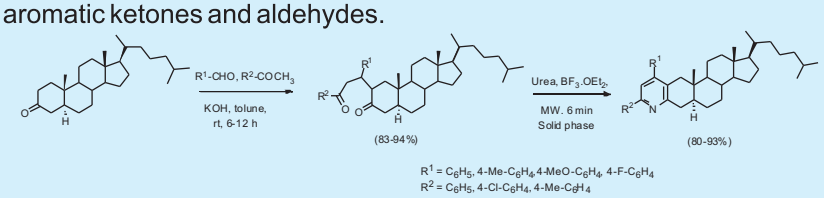
Development of a unique portfolio of plant and soil microbe derived bioactive extracts and pure compounds and their value addition involving partial & total synthesis

**PI & Members :**

Dr NC Barua PI
Dr PK Chowdhury
Dr MJ Bordoloi
Dr DK Dutta
Dr AM Das
Dr G Baishya

**Microwave-promoted and Lewis acid catalysed synthesis of steroidal A- and D-ring fused 4,6-diarylpyridines**

A solvent less one pot reaction of steroidal 1,5-diketo compound with urea for the synthesis of steroidal A- and D-ring fused 4,6-diarylpyridines using $BF_3.OEt_2$ as the catalyst was developed under microwave irradiation. The intermediate steroidal 1,5-diketo compounds were synthesized by Michael addition reaction of steroidal ketones with in situ generated chalcones from aromatic ketones and aldehydes.



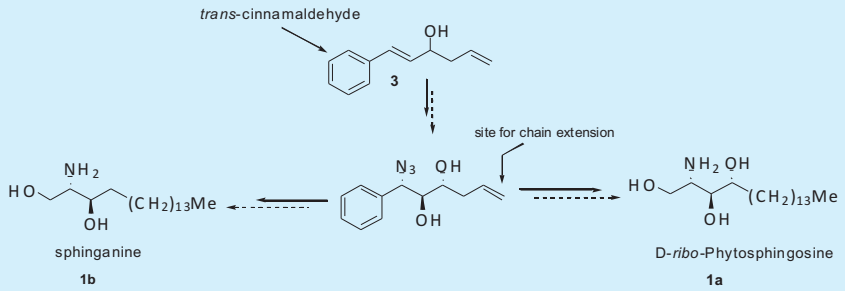

**Objectives:**

Under this programme besides working on phytochemical analysis of plants, work on chemical transformations of abundant natural products like diosgenin and solasodine is being pursued to add value to these molecules to develop soft-corticosteroids.

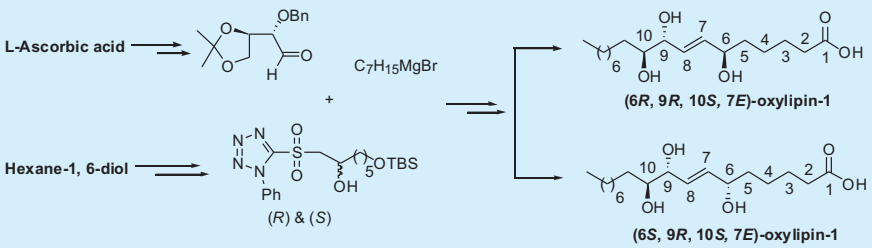
**Significant Achievements:**

Total syntheses of two sphingosine molecules sphinganine and D-*ribo*-phytoshingosine have been achieved using Sharpless asymmetric epoxidation of 2°-allylic alcohol. One oxlipin molecule has been also completed. Little novel chemical transformations on steroids have been completed. Isolation of Mahanine, the anti-prostate cancer alkaloid molecule is also done.

Stereoselective Total Synthesis of D-*ribo*-phytosphingosine and sphinganine from an achiral secondary homoallylic alcohol has been completed using Sharpless kinetic resolution.




Stereoselective Total Synthesis of both (6*R*,9*R*,10*S*,7*E*)-and (6*S*,9*R*,10*S*,7*E*)-Isomers of Immunostimulant Oxylipin (9*R*,10*S*,7*E*)-6,9,10-Trihydroxyoctadec-7-enoic acid has been achieved



Creation of value–added products from renewable resources: A green approach.

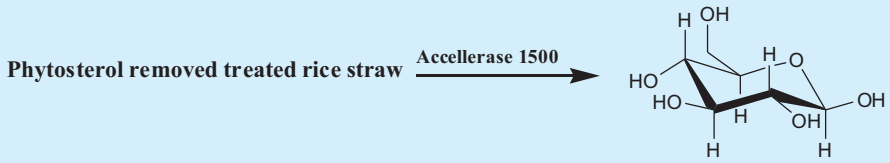
**PI & Members :**
Dr Dilip Konwar
Dr Amrit Goswami
Dr Pallab Pahari
Mr Ram N Das
Mr Manash Jyoti Bora

**Objectives:**

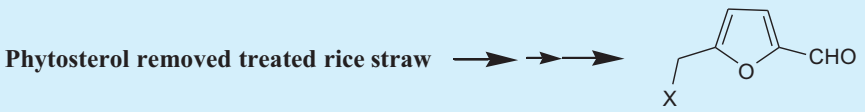
- ✓ Generation of cellulose, hydroxyl methyl furfural (HMF), chloromethyl furfural (CMF) etc as value-added products from renewable resources/ biomass such as agro wastes of rice straw, banana tree etc. using green methods.
- ✓ Conversion of cellulose to glucose and thus biologically important D - Mannitol and sorbitol using green chemical/ biochemical methods.
- ✓ Use of HMF, CMF and carbohydrates (generated from cellulose) as synthetic drug intermediates (imidazole, indole derivatives, macrocycles, levuliniac acid etc).

**Significant Achievements:**

1. Accelerase-1500 a very promising commercial celulase enzyme complex developed by Genecor for lignocellulosic biomass hydrolysis was collected from an Indian agent of Du Pont and carried out hydrolysis of phytosterol removed rice straw at a pH of around 4 to hydrolyse cellulose to glucose. Glucose formation could be observed with encouraging results.

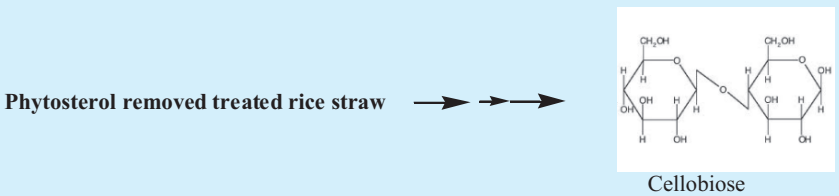



2. A process for the synthesis of hydroxymethyl furfural and chloromethyl furfural from rice straw using Bronsted acid in presence of alkali metal halides under pressure in water is in developing stage.




X= Cl or OH

3. A process development for the synthesis of cellobiose from pretreated rice straw using Bronsted acid is under progress.




Cellobiose

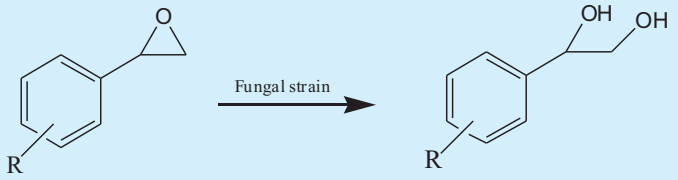
Studies on epoxyhydrolase activity of a microbial strain isolated from the North East genepool on some epoxy derivatives.

**Objectives:**

Stereo/regioselective hydrolysis of styrene oxides and other epoxy derivatives to diols using fungal strain isolated from the North East gene pool

**Significant Achievements:**

Hydrolysis of styrene oxide derivatives using isolated fungal strain of *Aspergillus* species revealed enantioconvergent hydrolysis of the epoxides to 1-phenyl ethane diol derivatives with 99% enantiomeric excess.




*R=Alkyl, Halo, Nitro etc. groups*

Natural polymer based nanocomposities and biodegradable polymers

**PI & Members :**
Dr SD Baruah PI

Member
Dr A Borthakur
Mr A Gautam
Mr NC Laskar
Mr A Sarmah
Mr RC Bohra
MT L Phukan
Mr RK Baruah

Objectives:

- ✓ *Development of biodegradable polymers and biocomposites from renewable resources.*
- ✓ *Development of natural polymer nanocomposites.*

**Significant Achievements:**

**Rheological behavior of biodiesel**

Increased awareness to use environmental friendly and sustainable alternative oils give impetus to the development of various types of vegetable based or bio based diesel oils. In order to successfully use these oils, an understanding of the oil properties is necessary to overcome the possible failures or obstacles that might occur in real operating conditions. Rheological property is one of the most important parameters and the current research provides an in-depth analysis of the influence of temperature on the rheology of biodiesel obtained from tea seed oil (Camellia sinensis L. Kuntze) blended with automotive diesel oil. The flow curves indicate that the oil belongs to Non-Newtonian behavior and the reduction of viscosity with increasing temperature followed an exponential relationship. An empirical equation was developed for predicting the viscosity of these fuel blends under varying temperatures and blend compositions.

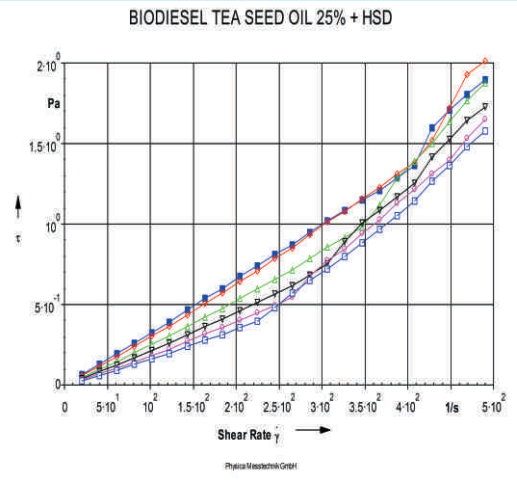



*Fig.: Shear stress versus shear rate plot of 20:80 blends of tea seed oil biodiesel: diesel at different temperatures. ( ) at 20 °C; () at 30 °C; () at 40 °C; () at 50 °C; () at 60 °C and () at 70 °C.*

**Biodegradable polymer based on renewable resources**

Photopolymerization kinetics of *Ricinodendron heudelotii* (RH) oil polymer in presence and absence of a photokiner is was established. The RH oil polymer undergoes three

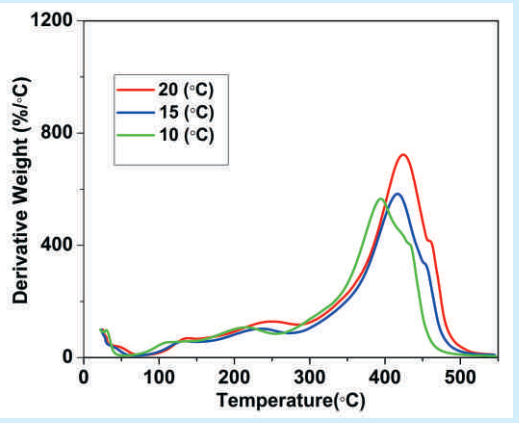



*Fig.: DTG curves of RH polymer at heating ranges of 10, 15, 20 °C in argon atmosphere*

Development of sensors for detection of pesticides

North East exploration for pharmaceutical

Synthesis of Some Versatile Steroidal Molecules: Approach To Synthesis of Hybrid Molecules Including Nine Membered D-Ring Steroids and Chemeric 7α-Substituted Derivatives

**PI & Members:**
Dr A M Das PI

**Funding Agency:**
DST, New Delhi

stage decomposition occurs at a temperature range between 300-500°C. Three non-isothermal methods have been used to evaluate the activation energy of thermal decomposition. RH oil polymer is thermally stable and can be used as raw material for the formulation of biodegradable polymer.

**Objectives:**
Steroid Transformations to get potentially biologically active steroid molecules and important steroid drug intermediates as well as one step simple route of micro wave assisted reactions, new reagents etc.

**Significant Achievements:**
A 'New Convenient Route for Synthesis of Steroidal 1,2,4,5-Tetraoxanes' has been developed

**GAP**

## Biodegradable Polymeric Composites Based on Cellulose Nanoparticles: an Alternative to Petroleum-Based Polymer Composites

**PI & Members:**
Dr S D Boruah PI

**Funding Agency :**
DST, New Delhi

The poly(α-caprolactone) (PCL) end group of cellulose microfibril-g-PCL graft copolymer was converted into initiating sites for atom transfer radical polymerization (ATRP) and the chain extension of the PCL block was done by grafting with poly(glycidyl methacrylate) (PGMA) and poly(methylmethacrylate) (PMMA). The effect of chain lengths of PGMA and PMMA on thermal properties of grafted materials was established. A detailed study on rheological behavior of CMF and grafted copolymer in water dispersions has been carried out and a peculiar rheological behavior in the shear rate between 0.1 and 1000 $s^{-1}$ was identified. The study confirmed a hysteresis loop in the shear rate viscosity relationship at low shear rates. Oscillatory measurements showed how the closeness of the fibrils helps network creation.

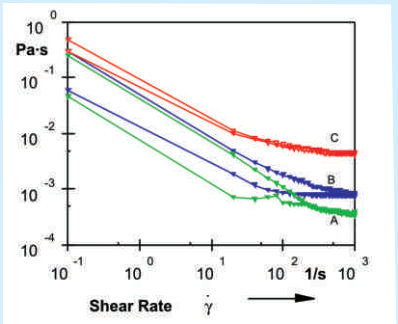



*Fig.: Rheological comparison of different CMF based samples at 25 oC: (A) neat CMF, (b) CMF-g-PCL and (c) CMF-g_PCL-g-PGMA.*

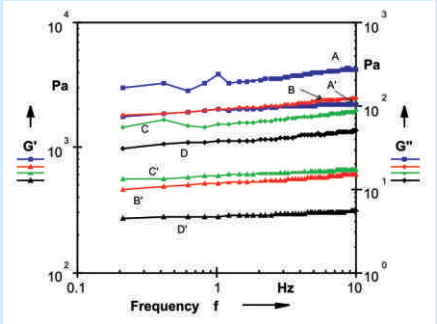



*Fig.: Oscillatory measurements - Storage (G') and Loss modulus (G") results at 25°C for polymer grafted CMF samples at different concentrations.*

**GAP**

## Synthesis of novel Pyrimidine Derivatives of biological significance based on inter and intramolecular cycloaddition strategy

**PI & Members:**
Dr Dipak Prajapati PI
Dr Romesh Ch Boruah CoPI

**Funding Agency :**
DST, New Delhi

**Objectives:**

- ✓ The main objective of the present proposal is to investigate the application of cycloaddition chemistry to the basic skeleton of pyrimidines to construct newer molecules of biological significance

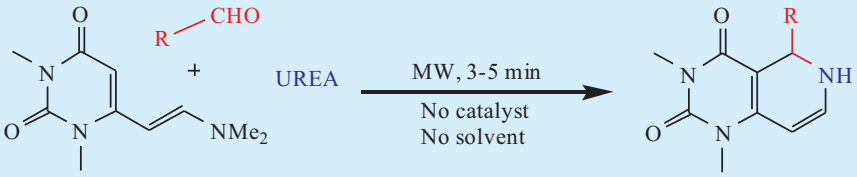
which will pave the way in devising a new methodology in the synthesis of complex natural products.

- ✓ The site selectivity and regioselectivity of the reaction
- ✓ The stereoselection or achieving the stereoselectivity in the end compounds using suitably modified dipoles or dipolarophiles.
- ✓ To accomplish the synthesis of bicyclic and polycyclic heterocycles by a one-step process and establish the possible pathways for the construction of basic skeleton of natural products.
- ✓ To evaluate the biological acitivity of some new nucleoside/pyrimidine derivatives synthesized.
- ✓ Naturally, as mentioned above, the theme is the development of new knowledge of the finest nature i.e. stereospecificity, regiospecificity and asymmetric synthesis.

**Significant Achievements:**

**Microwave Promoted Catalyst and Solvent-free Aza-Diels-Alder Reaction of Aldimines with 6-[2-(dimethylamino)vinyl]-1,3-dimethyl uracil**

An efficient aza-Diels-Alder strategy for construction of dihydropyrido[4,3-*d*]pyrimidine derivatives has been developed. A range of aromatic, heteroaromatic and conjugated aldehydes have been shown to participate in the reaction when carried out inside a microwave reactor in absence of any solvent or catalyst. The reaction can be suitably tuned simply by varying the reaction time to obtain aromatic pyrido[4,3-*d*]pyrimidines. It is further demonstrated that this methodology can be effectively exploited for the synthesis of dihydropyrimido[4,5-*d*]pyrimidines in an improved and eco-friendly way than previously reported procedures. Overall, this one-pot three-component technology is simple, efficient and provides an alternative towards removing organic solvents from organic synthesis.




**GAP**

**Utilization of Plant and Waste Materials of North-East India to a Value Added Product: Environment Friendly Technology**

**PI & Members:**

| | |
|---|---|
| Dr AM Das | PI |
| Dr Dilip Knowar | CoPI |
| Dr NC Barua | CoPI |
| Dr TC Bora | CoPI |

**Funding Agency:**
NEC, Shillong

**Objectives:**

- ✓ Collection of potential lignocelluloses bearing plants of North-East India for production of vanillin, ferulic acid, and ethanol.
- ✓ Extraction of lignocellulose components from plant materials and separation of lignin and cellulose.
- ✓ Conversion of cellulose to sugars by hydrolysis of green methods.

**Significant Achievements:**

- A process for the isolation of cellulose from rice straw, wood materials and other renewable resources were done.
- Preparation of vanillin from rice straw was done directly from rice straw.
- Preparation of cellulose acetate from cellulose was done

**GAP**

**Domino Prins Cyclization Reactions: Syntheses of novel highly functionalize tetrahydropyran and piperidine derivatives**

**PI & Members:**
Dr Gakul Baishya

**Funding Agency:**
DST, New Delhi

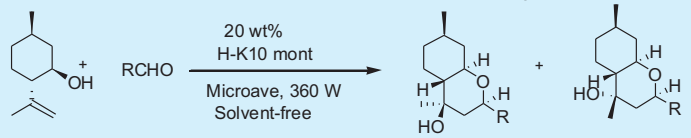
**Objectives:**

- ✓ To develop new domino Prins cyclization reactions as novel synthetic methods.
- ✓ To target some natural products of biological importance using aza-Prins cyclization reaction.

**Significant Achievements:**

Two solid acid catalysts ie HCl treated montmorrilonite K10 (H-K10 mont) and polyphosphoric acid treated silica (PPA-$SiO_2$) have been prepared and applied in Prins cyclization reaction of (-)-isopulegol with different aldehydes and ketones. A variety of octahydro-2H-chromen-4-ol have been synthesized in good yields and selectivitiers. H-K10 mont is found to be superior to various solid acid catalysts like K10 montmorrilonite, amberlyst 15, PPA-$SiO_2$ and other Bronted acids like p-TSA, HCl etc.

A research paper entitled "An environmentally benign synthesis of octahydro-2H-chromen-4-ols via modified montmorillonite K10 catalyzed Prins cyclization reaction" has been published in the journal *SYNLETT.*




## Engineering Sciences

**MLP**

**Studies on process intensification & integration of processes for bio-products, chemicals & fuels from bioresources & development of soil stabilization techniques**

**Funding Agency:**
CSIR, New Delhi

Studies onprocess intensification, integration, miniaturization and life cycle assessment for industrial bioproducts from natural feed stock and environmental control

Design and development of an integrated technology for drying of different agricultural product including heat sensitive one having export potential from high humid area like north eastern states of India using biomass as fuel

Study and development of soil modification or stabilization techniques for various types of soil used in construction activities in and around Jorhat and in some selected areas of Assam.

**PI & Members :**

| | |
|---|---|
| Mr Sanjay Deori | PI |
| Mr DipakBasumatari | Co-PI |
| Member | |
| Mr Tapas Das | |
| Mrs AnjumoniBharali | |
| Mr Nibir Pran Borah | |
| Mr MukeshAgarwal | |

**Objectives** :

- ✓ To develop soil improvement techniques used in road sub-grade/sub-base, airfields, embankment etc.
- ✓ To modify and improve engineering properties of soil with admixtures such as lime, cement, bitumen, fly ash or blends of any one of these materials and with use of reinforcements like geogrids, geotextiles, and waste materials etc.

**Significant Achievements**

Soil samples from different locations in and around Jorhat have been collected for laboratory analysis. RBI Grade-81 andCement is using as stabilizer in different proportion with collected soil samples. Experimental work in laboratory has been conducted for characterization of the collected soil and developed formulation to ascertain optimization of stabilizer required for soil stabilization in field application. Various lignocellulosic materials of NE region, and study on their physicochemical properties are in progress.

**GAP**

**Development of Nanostructured Membrane for Solvent Recovery from Dilute Solution**

**PI & Members :**
Dr (Ms) Swapnali Hazarika PI

Member
Dr MM Bora
Dr S Borthakur

**Funding Agency:**
DST, New Delhi

**Objectives:**

The main objectives of the work are to prepare flat sheet NF membrane from novel polymers and derivatives such as Graft Polymerization with MMA of Cellulose derivatives, i.e. Chitosan and Dendrimer. Composite of PS with finely dispersed oxide and optimize the casting conditions and characterize the membrane in respect of thickness, pore size and distribution, critical surface tension etc. The permeation behaviour of solvents from simulated effluent mixture of 2-3% concentration has to be studied using prepared membranes and compare their performance with model NF membranes available commercially to make a QSAR study for membrane permeabilities vs solute/solvent properties and optimize the operating conditions in a flat sheet membrane cell. The solvent-membrane interaction has to be established through systematic adsorption studies and analysis of adsorption interaction from Molecular Orbital Study. Suitable flux model for permeation in NF membrane has to be develop and simulate from experimental flux profile (C vs t) generated in test cell and evaluate the model parameter by numerical/statistical method.

**Significant Achievements:**

Permeation experiment for recovery of Acetic acid, Methanol, Ethanol, Butanol from aqueous solution (<3%) has been done using indigenously developed NF membranes and found that 85% recovery of the solvent has been obtained by our indigenously developed NF membrane. The performance of our indigenously developed NF membranes has been studied for process stream collected from Assam Petrochemicals Limited, Namrup, Assam and it was found that 99% rejection was obtained for methanol recovery which is an important solvent they marketed in India. Permeation model has been established and verified for above systems. Interaction energy between solvent and membrane material have been calculated by using software package and interpreted with flux data.

**GAP**

**Tezpur Footwear Training cum Production Centre at Tezpur of district Sonitpur, Assam**

**PI & Members:**
Mr Dipankar Neog PI

Member
Mr S C Kalita
Mr J J Bora

**Funding Agency:**
CSIR-CLRI through HRD Mission of Govt. of India

**Objectives:**

- ✓ To cater the demand of different types of footwear in the region.
- ✓ To encourage and create entrepreneurship in footwear industry.
- ✓ To generate trained manpower suitable for footwear industry.
- ✓ To run the centre in self sustainable basis.

**Salient Achievements:**

- First batch has completed their training programme.
- Commercial production will be started soon.
- Second batch of training is presently going on.

*Some of the facilities installed in the centre are shown below:*


*Counter Moulding Machine*


*Automatic Toe Lasting Machine*


*Heal seat lasting machine*


*Hydraulic clicking machine*

**GAP**

**PI & Members:**
Mr Dipankar Neog PI

Member
Dr Pranab Barkakati
Ms I Ilika Zhimo
Dr Dipanwita Banik

**Funding Agency:**
Department of Scientific and Industrial Research (DSIR)

## Technopreneur Promotion Programme (TePP) Outreach Centre of CSIR – NEIST, Jorhat (TUC-NEIST)

**Objectives:**

- ✓ To promote and support untapped creativity of individual innovators.
- ✓ To provide all necessary scientific and technical support to the innovators.
- ✓ To assist the individual innovators to become technology based entrepreneurs.
- ✓ To assist the technopreneur in networking and forge linkages with other constituents of the innovation chain for commercialization of their developments.

**Significant Achievements:**

- 5 (Five) projects under TS category (₹ 0.75 Lakhs) senctioned under TUC-NEIST has been completed successfully.
- Two projects (total cost of ₹ 32.4 Lakhs) are presently going on under TUC-NEIST Jorhat.
- 20+ enquiries have been generated.
- 7 (seven) projects are in pipeline for submission to DSIR, New Delhi.

*Mr. Gautam Borthakur of Jorhat has developed Multi Draft Thermal Biomass Gasifier*

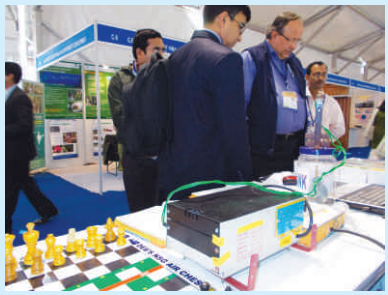
*Mr. Tapan Deb of Jorhat has developed a Modified Chess Game*

*Mr. Manoj Kumar Gogoi of Sibsagar has developed a Muga Reeling Machine*

*Mr. Naranraj Baruah of Selenghat has developed Jewelleries form Natural Fibers of Assam*

*Mr. Kamal Chandra Saikia of Jorhat has developed a Micro Light Hydro Turbine*

*Syed Abul Faruk of Jorhat has developed an Automatic Water Shut off Alarm*



*(left) Innovators from TUC NEIST has participated in the centenary celebration of National Science Congress at Kolkata during 3-7 January 2013 (right) Prof. Samir K Brahmachari, the honorable Director General of CSIR (DG-CSIR) has visited the TePP stalls at National Science Congress*

**GAP**

**Council of Science and Technology for Rural India (CSTRI) Center of CSIR – NEIST, Jorhat**

**PI & Members :**
Mr Dipankar Neog PI
Ms I Ilika Zhimo CoPI

Member
Dr Pranab Barkakati
Mr SC Kalita
Mr JJ Bora
Mr Dipak Basumatari
Mr Ajoy Barkotoki

**Funding Agency :**
Department of Science and Technology (DST)

**Objective:**

- ✓ To set up a Center for Council of Science and Technology for Rural India (CSTRI) which will act as an intermediate to solve the identified scientifically solvable problems of rural areas of North East Region (NER) of India through the inputs of funding, expertise domain experts, proved technologies, business scale up and overall monitoring of implementations of the projects.
- ✓ To develop the action plan of the center and form a core team to realize and implement the plan.
- ✓ To develop a format to evaluate the "Rural Resources and Need Appraisal" in the context of rural areas of the North East India.
- ✓ The center will identify the thrust areas in the rural NER such as- rural decentralized energy generation and distribution (e.g. bio-energy, solar energy, micro-hydral etc.); rural health including water, sanitation etc.; technology for bamboo based products & their value addition; appropriate technology for small tea growers; technology bases services during natural calamities like flood, earthquake etc.; technologies for food processing & preserving; technologies for mechanized cultivation; specific technologies for rural group having traditional expertise etc.
- ✓ Center would carefully assess the need and nature of the intervention required in the area at the specific location. Working along with the local groups in the rural areas, a proposal for interventions would be prepared and submitted to the council.
- ✓ The center will organize work-shop, training programme and technology demonstration in the identified areas.
- ✓ The center will provide secretarial assistance to the council for its activities.

**Significant Achievements:**

- The first implementation site is selected at New Sonowal of Assam Nagaland border where target beneficiaries are 800+ families.
- Detail base line survey was carried out to make the rural resource and need assessment in the above mentioned identified area.
- Rural resource and need assessment survey report was prepared and submitted to the council of DST.
- On the basis of this report two technology based development schemes namely: *"Setting up of A Common Facility Centre (CFC) on Weaving and Textile Product Manufacturing"* and *"Setting up of A Skill Development Training cum Production Centre"* are prepared and submitted to the council. The same was approved by the council of DST.

**GAP**

**Development of low cost process for fluoride removal from contaminated water specific to NE region for public use.**

**PI & Members:**
Dr (Mrs) Aradhana Goswami PI
Dr RL Goswamee Co-PI

Member
Mr Tobiul Hussain Ahmed

**Funding Agency:**
MoEF, New Delhi

**Objective:**

- ✓ Development of an economically feasible an environmentally sound simple process for defluoridation of water to provide potable water to the rural households.
- ✓ Gainful utilization of waste material like paddy husk ash and environmentally harmful weed like *Ipomoea Cornea* ash.

**Significant Achievements:**

- Modification of the carbonization unit by connecting a condenser unit to collect liquid and gas evaluated.

- Adsorbents were prepared by using Ipomoea cornea and rice husk ash coated with various percentage of inorganic solvent seperatly.
- The defluoridation study was carried out by that carbonized Ipomoea Cornea and Rice Husk ash as adsorbent. From kinetic study it was seen that defluoridation increases with increase in shaking time of fluoride water.

| GAP | **Economic Process for the Drying of UMOROK Chili and Turmeric and their quality evaluation with Stability Study.** |
|---|---|
| **PI & Members:**<br>Dr (Mrs) Aradhana Goswami PI<br><br>Member<br>Mr Tobiul Hussain Ahmed<br><br>**Funding Agency:**<br>Ministry of Food Processing Industry | **Objectives:**<br>✓ The main aim of the project is to develop a suitable economic method for drying Umorok chilli and turmeric. This chilli is one of the world's hottest chilli known as U-Morok or Umorok in Manipur and is abundantly available in the North Eastern region especially in Manipur. The local people know this type of chilli as king chilli after its extreme hot taste.<br>✓ In consideration of the congenial agro-climatic of the N.E region of India, considerable quantities of turmeric (Curcuma Longa) have been produced and their potentiality of increasing the cultivation to a great extent.<br><br>**Significant Achievements:**<br>● Drying characteristics of Bhut Jolokia was conducted at three different temperatures. First the chilli was dried at 70°C, then at 60°C and finally at 80°C. The effect of temperature on the effective diffusivity is often expressed using Arrhenius type relationship.<br>● Drying kinetics and modelling of the artificial drying process of Bhut Jolokia were investigated with different microwave power along with the observation of drying trends of turmeric.<br>● Drying isotherm using saturated salt solution at constant relative humidity and temperature was studied. |

| GAP | **Development of Molecular Gate Membrane for $CO_2$ Separation and Green Emission Control.** |
|---|---|
| **PI & Members:**<br>Dr Swapnali Hazarika PI<br>Dr Dilip Konwar Co-PI<br><br>**Funding Agency:**<br>DST, New Delhi | **Objectives:**<br>✓ Preparation and characterization of dendrimer and dendrimer derivatives following the scheme given in Scheme I and II and their characterization to make a comprehensive QSAR study in respect of molecular structure of dendrimer and its derivatives.<br>✓ Preparation and characterization of Molecular Gate membrane from dendrimer and dendrimer derivatives and optimize the preparation procedure followed by the studies on microvoid formation mechanism with respect to membrane preparation parameter.<br>✓ Extensive experimental study to understand permeation behavior of $CO_2$ using simulated biogas and develop appropriate flux model incorporating solute diffusion, mass transfer, adsorption effects and optimize the process for Spiral wound membrane module. |

| CNP | **Preparation of DPR for the proposed Common Facility Center (CFC) on Black-smithy** |
|---|---|
| **PI & Members:**<br>Dipankar Neog PI<br><br>Member<br>Mr SC Kalita<br>Mr JJ Bora<br><br>**Funding Agency:**<br>MSME | **Objectives:**<br>✓ Preparing the DPF of the Common Facility Center for the Black-smithy cluster of Karanga, Jorhat<br><br>**Significant Achievements:**<br>● Shop floor design for the CFC wad prepared.<br>● On the basis of the field survey, machinery requirements are identified. |

| CNP | Determination of Modulus of Soil Sub-Grade Reaction at Runway Extension for Air Force Station, Jorhat |
|---|---|

**PI & Members:**
Mr P Barkakati PI
Mr Sanjay Deori CoPI
Mr Dipak Basumatari CoPI

Member
Mr Nibir Pran Borah

**Funding Agency:**
Military Engineering Services, Air Force Station, Jorhat.

**Objectives:**
To determine Modulus of Soil Sub-grade Reaction K-value and Dry Density Tests at Air Force Station, Jorhat, Assam.

**Significant Achievements:**

- The plate load tests and field dry densities of soil were conducted at extension of *NPTT* passing through Nallah (*Location 1*), at extension portion of runway passing through existing service road (*Location 2*) and at extension portion of *NPTT* passing through existing service road (*Location 3*) after making necessary arrangement and permits for the working staff and equipments.
- Field dry density tests by sand replacement method *(04 Nos.)* were conducted at extension of *NPTT* passing through Nallah, at extension portion of runway passing through existing service road and at extension portion of *NPTT* passing through existing service road.

| CNP | Soil Investigation for Recycling Treatment Plant at Numaligarh Refinery. |
|---|---|

**PI & Members:**
Mr Sanjay Deori PI
Mr Dipak Basumatari CoPI

Member
Mrs Anjumoni Bharali
Mr Nibir Pran Borah
Mr Mukesh Agarwal
Mr Rajib Das

**Funding Agency :**
NRL, Golaghat

**Objectives:**
To determine safe bearing capacity of foundation soil.

**Significant Achievements:**

- Various Field Tests such as Standard Penetration Tests (SPT), Static Cone Penetration Tests (SCPT), and Electrical Resistivity Tests (ERT) were carried out.
- Laboratory Tests such as Atterberg Limit Tests, Consolidation Tests, Unconfined Compression Tests, Triaxial Tests, and CBR Tests etc. were carried out.

## Geo Sciences

| MLP | Seismic hazard risk assessment in NE India |
|---|---|

**PI & Members:**
Dr R Duarah PI

**Funding Agency:**
CSIR, New Delhi

**Objectives:**

- ✓ Integrated seismographic network of both sensitive and strong motion instrumentation for on-line earthquake monitoring and precursor studies to meet the long-term challenges of predicting rupture behavior in rocks
- ✓ Constant geodetic monitoring of crustal blocks to measure relative plate movement and current stress pattern
- ✓ Adoption of practical micro-zoning procedures and improvement of modeling strong ground motion by inclusion of field observation data
- ✓ Public awareness and Education towards seismic hazard –risk reduction: Scenario Earthquake and adoption of strategy using scientific knowledge, engineering and educational techniques

**Significant Achievements:**

- North East Wide Area Seismic Network (NEWSN) of 22 stations for on-line seismic monitoring and near real-time event location for NE India.
- Earthquake data acquired through the seismic network is processed, analyzed and hypocentral parameters determined for all the events originating in the NE India region.
- Precursory phenomenon of earthquakes is studied for different tectonic blocks and spatio-temporal variation of b-value, d-value, Vp/Vs is estimated.

- Estimated Vp/Vs for all the tectonic blocks following standard Wadati Diagram technique and analyzed variation of Vp/Vs with respect to time. Any change in Vp/Vs trend in relation to occurrence of major events is studied.
- Network of Strong Motion Seismographs for site specific ground motion estimation. - Peak Ground Acceleration, Velocity and attenuation characteristics
- Neotectonics & Shallow sub-surface deformations using GPR (Ground Penetrating Radar) supplemented by geotechnical data.
- Seismic microzonation of NE state capitals for appropriate land use and Urban planning.

| GAP | On-line/ Real-time Seismic Network for Disaster Mitigation in NE India |
|---|---|

**PI & Members:**
Dr R Duarah PI

**Funding Agency:**
North Eastern Council, Shillong

**Objectives:**

- ✓ Wide Area Seismic Network to monitor the seism city of NE India & adjacent region using state of the art VSAT technology.
- ✓ Unmanned operation of remote seismic observatories for on-line data and real-time event detection and location of epicentres.
- ✓ Seismicity trend, spatiotemporal variation and characterization of seismic activity along major tectonic lineaments
- ✓ Earthquake precursory signatures and Assessment of Seismic probabilities for different tectonic blocks.
- ✓ Routine Seismic update thorough web page and mail notification
- ✓ Publication of Annual Seismic Bulletin
- ✓ Develop strong collaborative linkages with NE State departments, creation of locally available trained manpower to intensify hazard-risk reduction programs in future
- ✓ Public awareness and education for hazard – risk reduction

**Significant Achievements :**

- Developed capability for continuous monitoring of local earthquake covering entire NE India thro on-line/real-time data transfer from 21 remote seismic stations.
- Sub-net comprising 10 (ten) seismic stations are established in Nagaland.
- Capability of issuing early warning based on S-P lead time
- Developed earthquake database of local earthquakes. The data are published in the form of Seismological Bulletins for the period 2007 - 2012.
- NEWSN (North East Wide Area Seismic Network) for disaster recovery and site specific early warning are under preparation.
- Technical support services for site specific mega engineering construction and feasibility of sites

| GAP | Active Tectonics & Paleoseismic studies,using Geophysical Parameters, along the mountain frontal part of Eastern Syntaxial Bend, Lower Dibang Valley and Lohit Districts, Arunachal Pradesh |
|---|---|

**PI & Members:**
Dr RK Mrinalinee Devi PI
Dr Pabon Kr Bora Mentor

**Funding Agency:**
DST, New Delhi

**Objectives:**

- ✓ Studies on Active Tectonics and Neotectonics activity of the study area with the help of structural as well as tectonic geomorphology
- ✓ Studies of the seismicity and past earthquakes of the northeast India for understanding the seismically unstable nature of the study area
- ✓ Paleoseismological measurements for estimation of the average recurrence interval of large/great earthquake

- ✓ Identification of the primary as well as secondary coseismic features in Holocene and late Pleistocene sediments

**Significant Achievements:**

The northwestern trending lithotectonic units of the Mishmi block are juxtaposed with the almost N-S trending eastern Himalayan lithotectonic units along the Siang fracture. Earthquakes occurring on the Indian peninsula are the outcome of the Indian plate under thrust towards the Eurasian continent. A large window in the Siang river section exposes Paleocene rocks interbeded with Abhor volcanic as the subthrust package and MBT as the roof thrust. Mishmi block, tectonically separates the eastern Himalayan and the Indo-Myanmar mobile belts and form 'a linkage' in between. Active faulting along the Himalayan Front is observed. Left-lateral strike slip faults displacing Mishmi Thrust Zone had been observed. Morphological and sedimentary records at Siang, Dibang and Lohit rivers at Pasighat, Dambuk, Roing, Tezu and Parsuramkund areas in the NE Himalaya were studied with the help of terraces, for the evidences of the climate-tectonic interplay. Drainage maps were prepared and structurally controlled drainages were observed in the study area. Mishmi Thrust zone is found to be tectonically active with the uplifting of the Quaternary fluvial sediments for a height of about 40m from the present day river channel

Geophysically, the epicentral plot and b-value plot of the Eastern Syntaxial area were plotted. Faulting and thrusting suspected zones were identified for GPR( Ground Penetrating Radar) studies in the frontal areas of the Eastern Syntaxial Bend region. Site specific local earthquakes revealing the structural alignments and features are yet to be done, by learning to locate the origin of earthquakes.

**GAP**

**Literature Survey of available Earthquake Hazard Assessment Studies related to North Eastern Region**

**PI & Members:**
Dr Saurabh Barua PI
Dr Pabon Kumar Bora Co-PI

**Funding Agency :**
Assam State Disaster Management Authority, Guwahati

**Objectives:**

- ✓ To create high quality database based on literature survey related to earthquake hazard and its mitigation related studies.
- ✓ To determine standard benchmark required for Earthquake Hazard Assessment Studies.
- ✓ To prepare earthquake catalogue of Northeastern region of India from medieval period to present (2012).

**Significant Achievements:**

Compiled and submitted to ASDMA the First Interim Report of the 'Literature Survey' project in the form of an Earthquake Catalogue of Northeastern region of India from the Medieval period to 1999. The catalogue comprises of about 7843 events with the Day of occurrence, Origin time, Epicenter (Latitude & Longitude), Depth (km), Magnitude and the concerned agency. Six epicentral plots with magnitudes have been prepared from the database as follows:

(a) Epicentral plot from Medieval period to 1885 (65 earthquakes)
(b) Epicentral plot from 1897 to 1949 (177 earthquakes)
(c) Epicentral plot from 1950 to 1969 (351 earthquakes)
(d) Epicentral plot from 1970 to 1979 (329 earthquakes)
(e) Epicentral plot from 1980 to 1989 (2127 earthquakes)
(f) Epicentral plot from 1990 to 1999 (4794 earthquakes)

Description of some of the historical earthquakes of undivided Assam from historical records has been included and are as follows

(i) An earthquake at Garhgaon, 1548 AD *(Ahom Buranji, pp. 81-82, para 61)*
(ii) An earthquake at Gajala in 1596 AD

(iii) Several earthquakes in Upper Assam in 1642 AD (History of Assam, Gait 1905)
(iv) Three earthquakes in Upper Assam in April-May, 1649 AD (Satsari Buranji)
(v) Mild earthquakes Kajali, near Gauhati, 1663 AD *(Fatehiya-e Ibriya, pp. 186-87)*
(vi) An earthquake at Tingkhang and Charaideo Hill in 1714 AD (*Tungkhungia-Buranji,)*
(vii) Destruction of Kamakhya temple, earthquakes prior to 800-1700 AD

Further, the earth science studies of the region in different aspects of seismology including the works carried out by various organizations, Universities etc. are incorporated.

| GAP | Seismic Vulnerability Assessment of Major cities in North-Eastern India |
|---|---|

**PI & Members:**
Dr Saurabh Barua PI
Dr Pabon Kumar Bora Co-PI

Member
Er Sanjay Deuri
Mr Dipak Basumatari
Ms Sangeeta Sharma

**Funding Agency :**
North Eastern Council, Shillong

**Objectives :**
To develop earthquake damage scenario this describes the consequences of possible earthquake

- ✓ *Seismic hazard assessment*: To select the hypothetical earthquake to be adopted for use in the project and to estimate the distribution of seismic intensities for the adopted earthquake.
- ✓ *Seismic vulnerability and risk assessment*: The objective of the vulnerability assessment is to prepare vulnerability functions and recovery functions that are applicable to local conditions.

**Significant Achievements:**
1. Site amplification characteristics of Shillong city have been estimated.
2. Microearthquakes spectra from Shillong region are analyzed to observe the effect of attenuation and site on these spectra. The spectral ratio method is utilized in order to estimate the Q values for both P and S-wave in subsurface layer wherein the ratio of spectral amplitudes at lower and higher frequencies are taken into consideration for three stations at varying epicentral distances. Average estimates of $Q_P$ and $Q_S$ are 178 and 195. The ratio of $Q_S$ to $Q_P$ was estimated to be greater than one in major parts of Shillong area which can be related to the dry crust prevailing in Shillong region. The variation in corner frequencies for these spectra is inferred to be characteristics of the site. Simultaneously, observation from spectral content of local earthquakes recoded at two stations with respect to reference site yields greater amplification of incoming seismic signal in the frequency range of 2 to 5 Hz which is found to be well supported by the existing local lithology pertinent to that region.

## Materials Sciences

| MLP | Value addition through environmentally benign and clean processes for catalyst, metal oxides, coal and lingo-cellulosic materials |
|---|---|

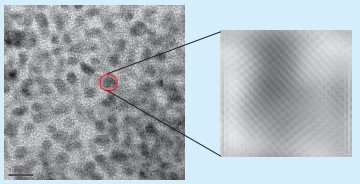
**Funding Agency:**
CSIR, New Delhi

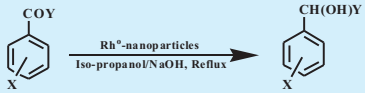
"Development of Efficient and Benign Catalysts and Catalysis" $Rh^0$-nanoparticles: Implication in transfer hydrogenation of aromatic carbonyl compounds.

**Significant Achievements:**
$Rh^0$-nanoparticles of around 4 nm size distributed homogeneously into nanopores of acid activated Montmorillonite clay were generated by incipient wetness impregnation of $RhCl_3$. Acid activation of the Montmorillonite clay was carried out by treating with $H_2SO_4$ under controlled condition to increases the surface area by generating nanopores upto about 10 nm sizes, which act as a host and stabilize nanoparticles into the pores. The supported metal

**PI & Members:**
Dr D K Dutta PI
Dr P Sengupta Member

nanoparticles serve as efficient heterogeneous catalyst for reduction of some important aromatic carbonyl compounds leading to corresponding alcohol through transfer hydrogenation upto 100% conversion and selectivity. The catalysts remained active for several runs without significant loss of their catalytic activities.






For entry 1, 2 and 3: X=H; Y=H, $CH_3$ and Ph
For entry 4, 5 and 6: X= OH, $CH_3$ and $OCH_3$; Y=H

Bacterial adhesion on the metal oxides surfaces

**PI & Members:**
Dr M R Das PI
Sr S Mahiuddin Member

**Significant Achivements :**
The indents for materials and chemicals are processed.
Relevant literature survey initiated.

Clean Coal Initiatives for North East Indian Coals.

**PI & Members:**
Dr BP Baruah PI

Member
Dr Binoy Kumar Saikia
Dr Prasenjit Saikia
Mr Dilip Kumar Dutta
Mr Tonkeswar Das

**Objectives:**
- ✓ Resource Quality Assessment
- ✓ Utilization potential of NE coals
- ✓ Studies on heterogeneous mineral matters
- ✓ Study of environmental issues related to coal based industries.

**Significant Achievements:**

- **Thermal Properties of NER coal:** TGA-DTG, combined TG ignition and DTG was adopted to determine the ignition temperature of coal.

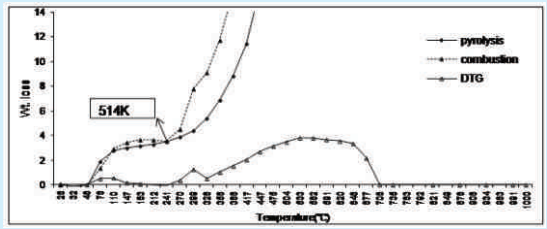



*Fig. : combined TG ignition and DTG profile diagram for determination of Ignition temperature*

- **Molten caustic leaching (MCL) of NER Coal samples:** NER coal with molten alkali reduces Sulfur and Ash by 50% and 90% respectively.
- **Sequential acid leaching to produce clean coal:** The oxidised NER coal sample on washing with acid reduces ash content (80%) and small amount of sulphur.
- **Agglomeration of coal fines:** Nodulization has to gainful utilization of non-caking coal fines in the domestic & Industrial sector.

*Fig.: Nodulizer Pan for Agglomeration Technology*

Sustainable development of high valued products and processes from lignocellulosic bio resources of North East India.

**Objectives:**
Development of process/Products/Technology utilizing the lignocellulosic materials of NE India and socio economic development of the rural areas of NE region by dissemination of developed technology.