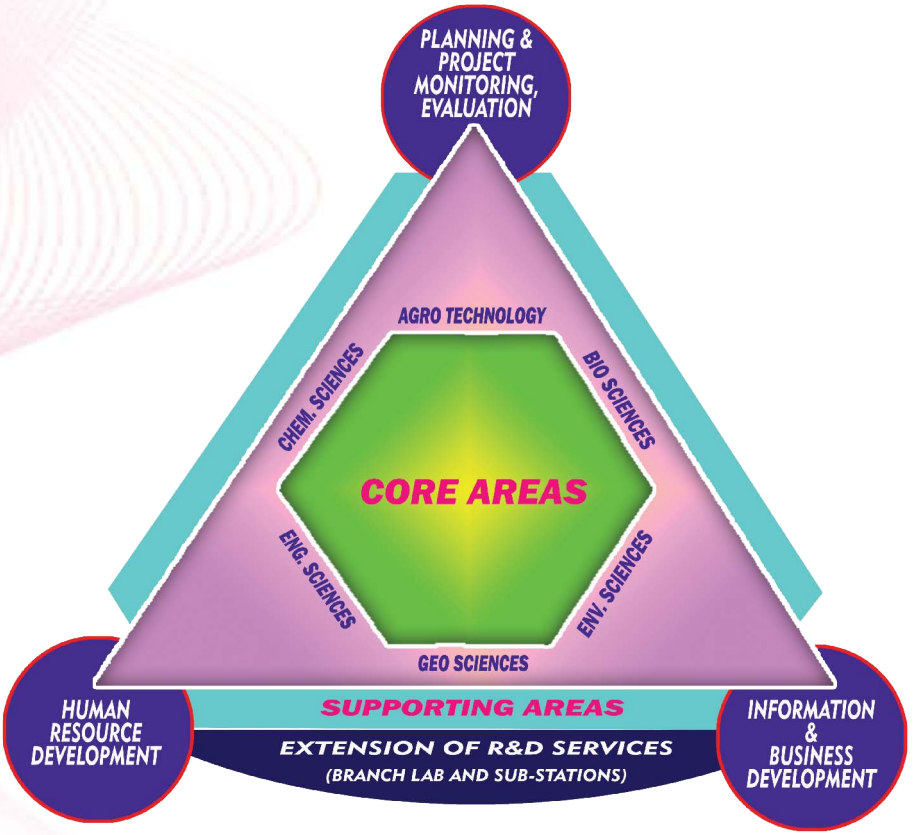
Annual Report 2011-2012

CSIR-North East Institute of Science & Technology
Jorhat



QUALITY POLICY OF CSIR-NEIST

CSIR-North East Institute of Science & Technology, Jorhat is committed to achieve excellence with quality outputs in R&D in frontier areas, professional consultancy and contract services in Chemical, Biological and Allied Sciences to be offered to customers in public and private domains at national and international levels.

CONTENTS

About CSIR-NEIST Jorhat

The governing body of CSIR in its 168th meeting held on 8 December, 2006 decided renaming of five Regional Research Laboratories (RRLs) of CSIR located at five different regions including the one at Jorhat commensurating with their direction, orientation of expertise and excellence developed over the years. Accordingly, the RRL's name was formally changed to North East Institute of Science & Technology (NEIST) with effect from 18 March, 2007, the 46th Foundation Day of the Institute. The NEIST (erstwhile RRL) at Jorhat (Assam) was established in the year 1961 as one of the multidisciplinary CSIR laboratories. It is worth mentioning here that the constituent laboratories of CSIR have been grouped into five broad areas such as physical sciences, chemical sciences, biological sciences, engineering sciences and information sciences depending upon the type of work, objective and the nature of responsibilities vested on these laboratories. On this basis the NEIST is one among the seven other laboratories under the Chemical Science group. The major thrust of R&D activities of NEIST Jorhat has been to develop indigenous technologies and knowledgebase by utilizing the immense natural wealth of the North Eastern region of India. The North Eastern region of the country being bestowed with an abundance of material resources like petroleum, natural gas, minerals, tea and aromatic & medicinal plants and hence the laboratory was assigned to undertake research for development of expertise and know-how for a wide range of industries and extension works. Over the years, the institute has generated more than 100 technologies in the areas of Agrotechnology, Biotechnology, Chemical Sciences, Engineering Sciences, Environmental Sciences and Petroleum and Oil Field Chemicals of which about 60% were commercial successes culminating in setting up of various industries throughout the country. The Institute also developed expertise in the areas like natural products chemistry, drugs and drug intermediates, VSK cement technology, agro-technologies, petrochemicals, crude-oil transportations, paper and paper products, beneficiation chemicals, ecology and environment studies, geotechnical investigations, foundation design engineering, soil investigation and building materials.

These tasks of the Institute have to be focussed and tuned-up differently at different points of time in accordance with the national commitments and priorities. The Institute also has tie-up with other research and academic institutions for functional and other coordinations for HRD and S&T developments of the region in particular and the country as a whole. Effects have also been made to further evolve the Institute as a lead S&T player in the present global scenario.

From the Director's Desk

It gives me immense pleasure to present before you the Annual Report for the year 2011-2012. The report will provide a glimpse of the various activities and achievements of the laboratory performed in terms of research & development, network projects, processes released, papers published, patent filed, human resource development, societal benefits, seminar, symposium, meetings organized, honour & recognition, awards, etc against the backdrop of various national priorities and commitments. It is indeed very satisfying that the dedicated band of NEIST staff made the best endeavour to fulfill the tasks expected of them with greater degree of successes.

The year had been an eventful one for the laboratory registering all-around progresses and achievements in almost every front starting from earning reasonable cash flow of Rs. 4,66,23,000.00. During the year, four technologies were transferred to six parties in the state of Assam. On the publication side, the laboratory published a total of 96 research papers in reputed national and international journals with an average impact factor of 2.751 which is a significant improvement over the previous years. On the IPR side, 3 Patents were granted in India while 4 patents were filed abroad and 3 in India. During the period three Consultancy projects and six grant-in-aid projects were undertaken worth at Rs. 10,50,350.00 and 178,20,000.00 respectively.

An International Symposium on Frontier Areas-II (ISOFA-II) was organized under the aegis of Golden Jubilee celebration. The year 2011-2012 also marked the completion of Golden Jubilee Year celebration of the Institute, for which a special Golden Jubilee function was organized in November, 2011. During the period, a number of foreign scientists and delegates from China, Canada and Thailand visited the Institute. The Institute also signed several MoUs and agreements during the period for strengthening research collaboration and development of S&T personnel. Significantly enough, a bilateral MoU was signed at international level with the Agricultural Research Development Agency (ARDA) of Thailand.

The year also marked the end of the 11th Five year plan. Consequently the research groups put up efforts to complete the projects due for completion during the plan successfully. Simultaneously they also put efforts in preparing the research proposals for the 12th Five year plan, by engaging with the intracluster and intercluster groups.

During the period, the laboratory had organized number of important events such as National Seminar on Plants in Diabetes, State Level Science Exhibition cum Technology Demonstration Workshop, Consultative Workshop on Climate Change, Interactive meet with small tea planters, Workshop cum Training on 'Sericulture for Healthy Larvae and the Production of Quality Muga Silk', National Workshop on Sustainable Road Technologies, Workshop on Hazards, Workshop on Documentation and Assessment of Local Health Traditions, Round Table Workshop on Civil Infrastructure technologies for NE region, to name a few.

On the societal front, CSIR-NEIST conducted a series of awareness cum training programme on Mushroom cultivation technique under CSIR 800 programme in various places of Assam, Tripura, Arunachal Pradesh, Mizoram and Tamil Nadu, benefitting large number of unemployed youths, NGOs, Self Help Groups, etc. The Institute also acted as a nodal laboratory in organizing a two-day demonstration cum workshop on CSIR rural technologies held in February, 2012 at Agartala, Tripura.

In the area of human resource development 9 research scholars were awarded PhDs in various disciplines of science by various universities, the Institute organized a series of programmes for motivating the students for taking up science career right from their school level. Similar programmes were also conducted for science faculties of the region. Besides, summer/winter trainings were imparted to the college level science students.

I feel proud to mention that like previous financial year, this year also, the Institute received the CSIR Technology Award 2011 in Life Sciences for developing the technology on 'Terminalia chebula based bioformulation called 'Muga Heal'- which is an anti-flacherie agent and a silk fiber enhancer'.

(P G Rao)
Director

CSIR-NEIST JORHAT AT A GLANCE 2011-2012

RESOURCE BASE

Infrastructural	
R&D Department	13
Branch laboratory	01
Sub-stations	01
Seismic stations	13

HUMAN RESOURCES

Total S&T Staff	**393**
Scientist(Gr IV)	85
Technical (Gr III)	72
Technical (Gr I + II)	140
Total Administrative Staff	**96**

FINANCIAL

	(Rs in lakh)
Government Allocation	4260.000
From Contract R&D and Consultancy	441.626
Testing/Analytical services	23.201
Miscelleanous	0.860
Royalty/Premia	0.49

BUDGET

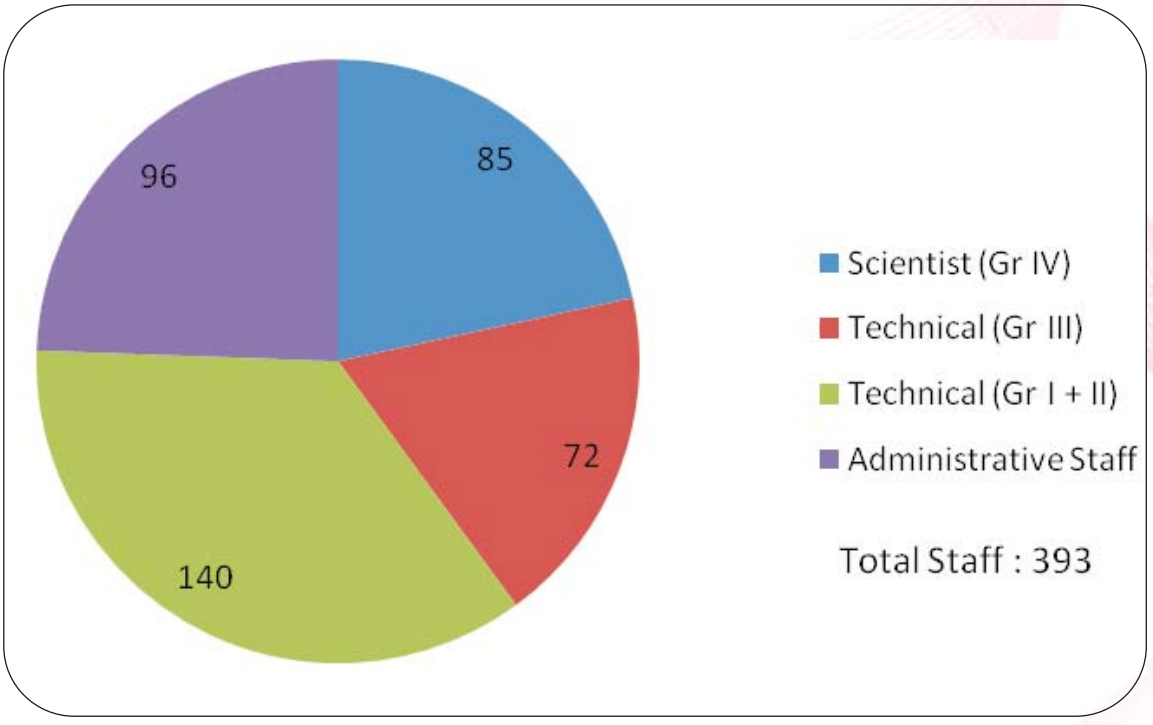
	Sanctioned (Rs in lakh)	**Expenditure** (Rs in lakh)
General Head		
Recurring	2773.400	2773.400
Capital	620.000	620.000
Network Project		
Non Recurring	557.906	557.906
Recurring	308.675	308.675

R&D PERFORMANCE : 2011-2012

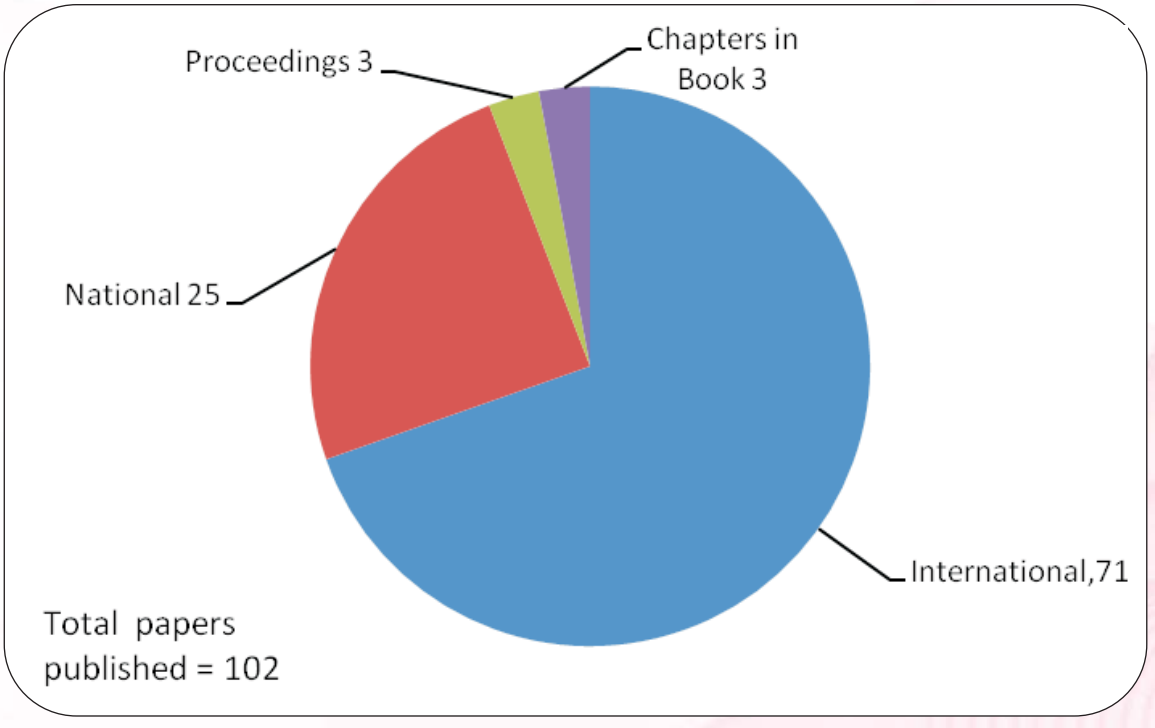
Contribution to Economy		Rs. in crore (Aprox.)
	Industrial production based on NEIST-Jorhat know-how	>100.00
Science Output		
	Total papers published	102
	International	71
	National	25
	Chapters in Book	03
	Proceedings	03
	Average IF	2.751
	Highest IF	**12.110**
Technological Output		
	Process developed	
	Processes released to industry	
Extramural & Human Resource Development		
	Quick Hire Fellow	03
	DST SERC Fast Track YSS	01
	Woman Scientists (DST)	04
	Sr Research Fellows	
	SRF-NET	07
	SRF	02
	Jr Research Fellows	
	JRF-NET (CSIR)	02
	JRF-NET (UGC)	07
	JRF-MANF-UGC	01
	JRF-DST-INSPIRE	01
	Project Assistants	
	(Level I)	19
	(Level II)	63
	Guest Workers	06
	Teacher Fellow	01
	DBT-TWAS Fellow	01
	Junior Scholar, Lady Tata Memorial Trust	01
Resource Mobilization		(Rs. in lakhs)
	Government Allocation	
	From Contract R&D and Consultancy	441.626
	Testing/Analytical services	23.201
	Miscelleanous	0.860
	Royalty/Premia	0.49
Patent Filed		
	In India	03
	Abroad	04
Patent Granted		
	In India	03

PERFORMANCE INDICATOR

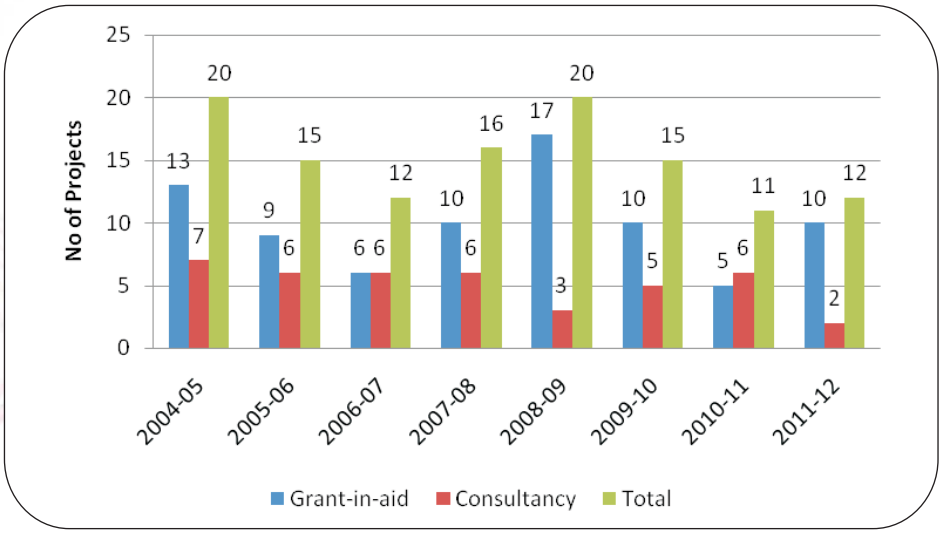
HUMAN RESOURCE: 2011-2012



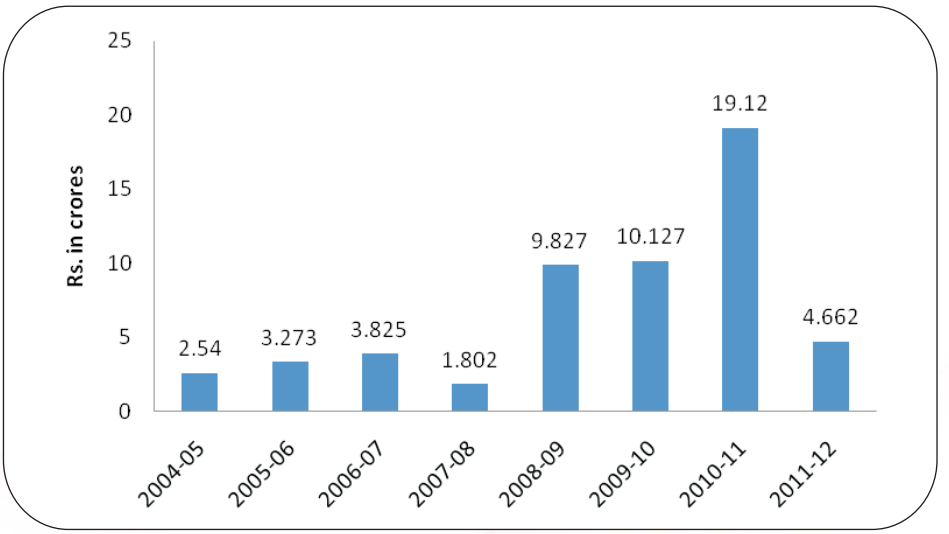
PAPER PUBLISHED : 2011-2012



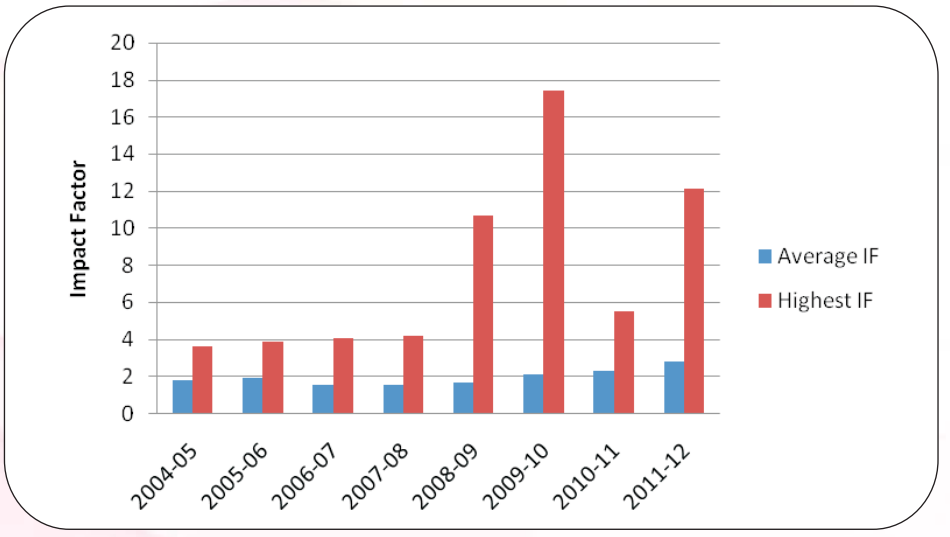
FUNDED PROJECTS COMPLETED 2004-05 TO 2011-12



EXTERNAL CASH FLOW 2004-05 TO 2011-12



IMPACT FACTOR 2004-05 TO 2011-12



MEMBERS OF RESEARCH COUNCIL
2010-2013

Prof Harsh K Gupta
Former Secretary, DOD
Rajaramanna Fellow
NGRI, Uppal Road
Hyderabad 500 007

Chairman

Prof Mihir K Choudhury
Vice Chancellor
Central University
Tezpur 784 028

Member

Prof Samir Bhattacharya
Former Director, IICB-Kolkata
Professor & INSA Fellow
Department of Life Sciences
Visva Bharati
Santiniketan 731 235

Member

Prof G D Sharma
Pro Vice Chancellor
Assam University
Silchar 788 011

Member

Prof Bharat B Dhar
Former Director, CMRI-Dhanbad
Vice President, Ritnand Balved
Education Foundation
D-20, Pamposh Enclave
New Delhi 110 048

Member

Dr Bakulesh Khamar
Executive Director (Research)
Cadila Pharmaceuticals
"Cadila Corporate Campus"
Sarkhej Dholka Road, Bhat
Ahmedabad 382 210

Member

Prof K Krishnaiah
Dean (Academic Research)
Indian Institute of Technology,
Madras
Chennai 600 036

Member

Shri P P Shrivastav
Member,
North Eastern Council
Taxation Building
Shillong 793 001

Member

Dr P K Biswas
Former Advisor (S&T)
Planning Commission
MS-11/905
Kendriya Vihar, Sector 56
Gurgaon 122 003

Member

Prof Ram Rajasekharan
Director
CSIR-Central Institute of
Medicinal and Aromatic Plants
Lucknow 226 015

Member

Dr M O Garg
Director
CSIR-Indian Institute
of Petroleum
Dehradun 248 005

Member

Dr P G Rao
Director
CSIR-North East Institute of
Science & Technology
Jorhat 785 006

Member

Dr L Nath
Chief Scientist
CSIR-North East Institute of
Science & Technology
Jorhat 785 006

Secretary

MEMBERS OF MANAGEMENT COUNCIL 2011-2012

Dr P G Rao
Director
CSIR-NEIST, Jorhat

Dr Neelima Saikia
Principal Scientist
CSIR-NEIST, Jorhat

Prof Siddhartha Roy
Director
CSIR-IICB, Kolkata

Dr P J Bhuyan
Principal Scientist
CSIR-NEIST, Jorhat

Dr R C Boruah
Outstanding Scientist
CSIR-NEIST, Jorhat

Dr Thaneswar Bora
Medical Officer
CSIR-NEIST, Jorhat

Dr N C Barua
Chief Scientist
CSIR-NEIST, Jorhat

Mr Parag Patar
F&AO
CSIR-NEIST, Jorhat

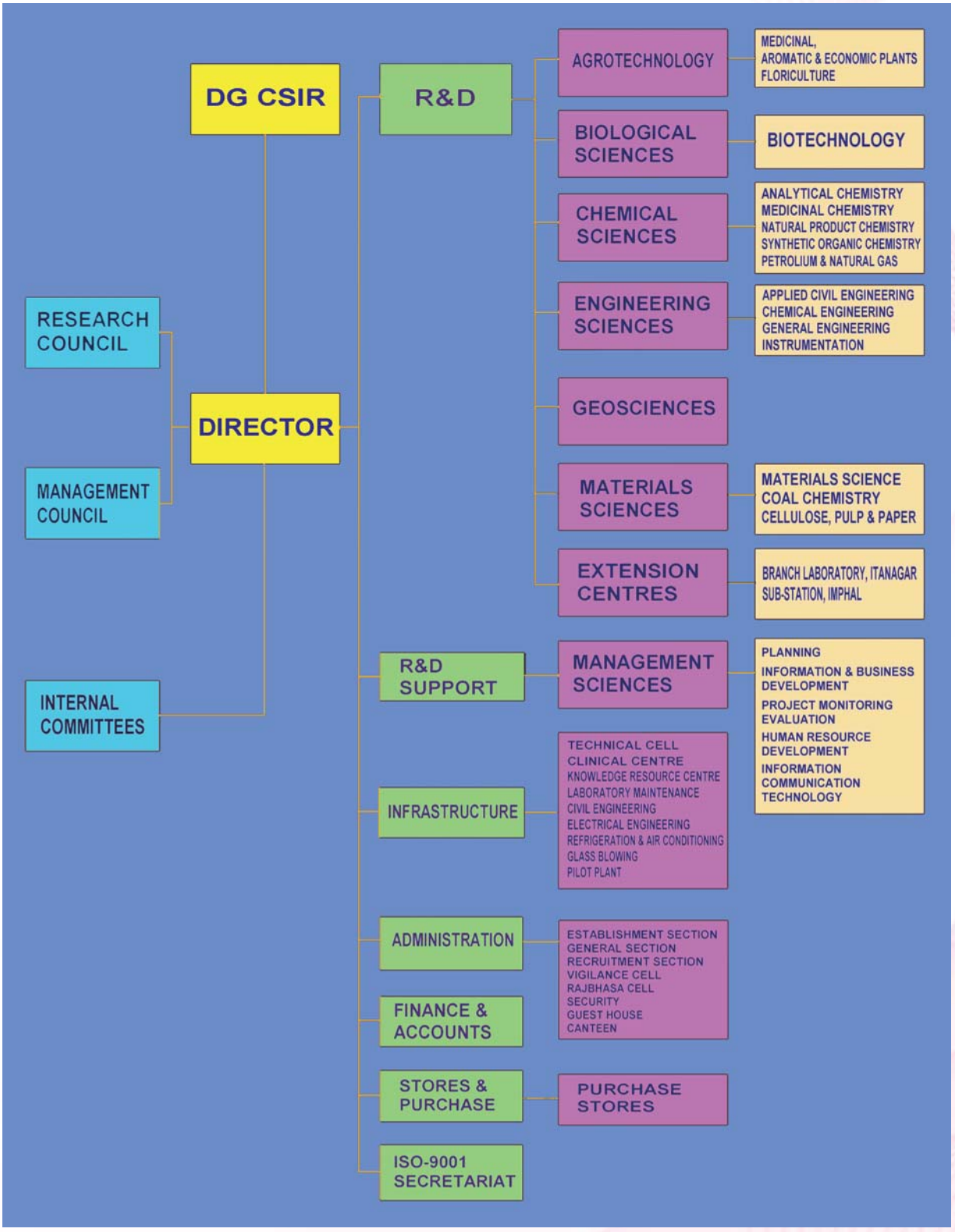
Dr L Nath
Chief Scientist
CSIR-NEIST, Jorhat

Sri SK Pal
Administrative Officer
CSIR-NEIST, Jorhat

Since Changed WEF 01.01.2012

Director, CSIR-NEIST	Chairman
Dr Amalendu Sinha, Director, CIMFR, Dhanbad	Member
Dr Dipak Kr Dutta, Chief Scientist, CSIR-NEIST	Member
Dr B P Baruah, Principal Scientist, CSIR-NEIST	Member
Dr Ratul Saikia, Sr Scientist, CSIR-NEIST	Member
Dr (Mrs) Swapnali Hazarika, Scientist, CSIR-NEIST	Member
Dr P K Baruah, Medical Officer (Pr Technical Officer), CSIR-NEIST	Member
Dr M C Kakati, Sr Principal Scientist, CSIR-NEIST	Member
Controller of F&A/ Finance and Accounts Officer, CSIR-NEIST	Member
Controller of Administration/ Administrative Officer, CSIR-NEIST	Member-Secretary

ORGANIZATION CHART



R&D ACTIVITIES

A) International Collaboration

International Collaboration	Stereoselective multi-component organometallic reactions and synthesis of bioactive molecules using green methodologies

PI (India)-
Dr Dipak Prajapati

CoPI-
Dr Romesh Ch Boruah

PI (China)-
Prof Wenhao Hu, East China Normal University, Shanghai, P R China

Funded by:
CSIR-NSFC China

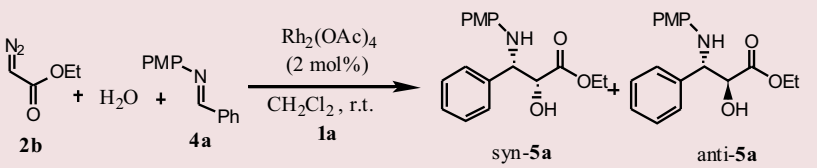
Objective

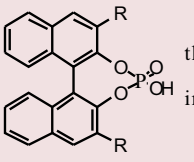
The present proposal was based on the following objectives with an emphasis to develop simpler methods involving environmentally friendly multi-component reactions.

- To study the reactivity, regioselectivity and stereoselectivity of the organometallic reactions.
- To accompolish the synthesis of novel bioactive molecules by a multi-component one pot process and set the pathway for the construction of basic skeletons of natural products.
- To develop new knowledge of stereospecificity, regiospecificity and asymmetric synthesis.

Salient Features

As a part of Indo-China international collaborative project a new strategy to synthesize optically active b-amino-a-hydroxyl acid derivatives bearing two stereogenic centers via chiral Bronsted acid $Rh_2(OAc)_4$ cocatalyzed three component reactions of diazo acetates with alcohols and imines was developed. A matched reaction system was identified to give the products in moderated diastereoselectivity and good enantioselectivity. The desired product b-amino-a-alkyloxy ester was isolated in 58% yield with a dr of 46:54 and the enatioselectivity is 20%. In order to enhance the enantioselectivity, the reaction was studied by using alcohol, a recemic Bronsted acid (BH) to activate the imine and tert-butyl diazoacetate. The reaction gave a slightly better result. The ratio to the desired syn diastereomer slightly improved from 37:73 (syn:anti) to 45:55 with a higher ee (49% vs 35%) of the syn isomer. The application of this methodology, was demonstrated in the efficient synthesiss of a taxol side chain and (-)epi-cytoxazone. This is first time that the highly efficient ylide-trapping process is applied for the synthesis of pharmaceutically interesting molecules.



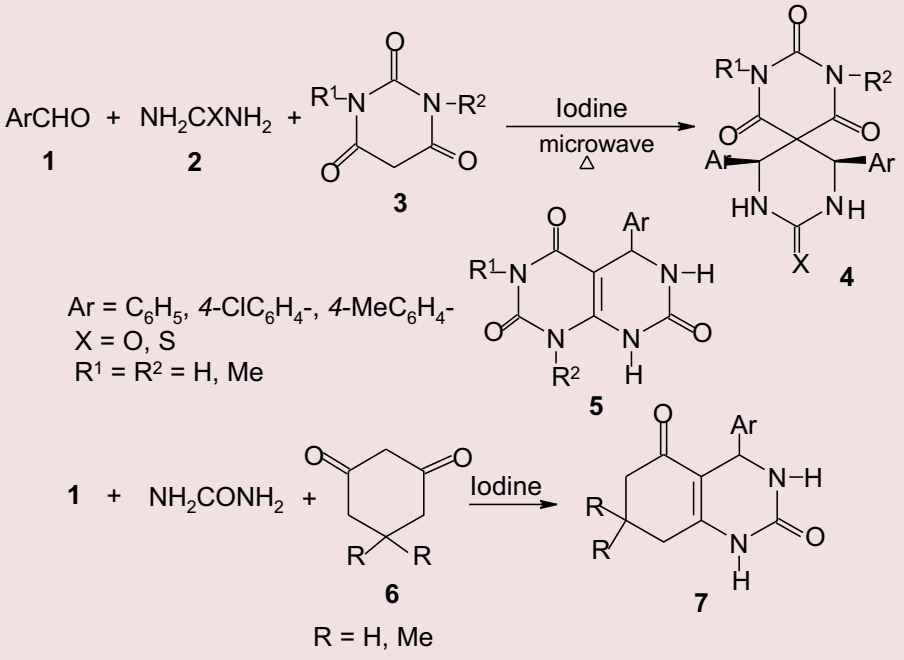


R = 9-phenanthryl
1a

this work with 5 mol% **1a** yield 58 %, dr (syn:anti) 46:54, ee (syn): 20%

in absence of **1a** catalyst yield 48%, dr (syn:anti): 63:37

Moreover, the pseudo four-component Biginelli-type condensation of barbituric acid, urea/thiourea and aldehyde in presence of 1 mol% of iodine under microwave irradiations was performed. The corresponding symmetrical spiroheterocyclic compounds were obtained in excellent yields.



Scheme 1

This molecular iodine-catalysed one-pot synthesis of spiro heterocycles is therefore simple, high yielding, time-saving and environment friendly process. Moreover, expensive rare earths or strong Bronsted acids or costly metal salts like indium were not used rather it employed inexpensive catalyst like iodine.

International Collaboration

PI (India)-
Dr Pulakjyoti Bhuyan

PI (Taiwan) –
Prof Biing-Jiun Uang
Department of Chemistry, National Tsing Hua University
Hsinchu, Taiwan 30013

Funded by:
Confederation of Indian Industry, through GITA-DST, New Delhi

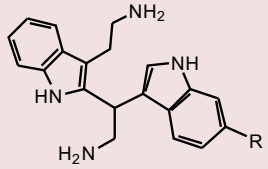
An approach to the total synthesis of (±)gelliusines class of marine alkaloids of biological significance and asymmetric synthesis of 3,3′-diindolyl methanes.

Objective

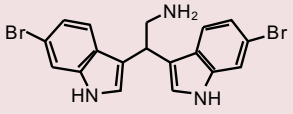
The objective of the project was to achieve the total synthesis of (±)gelliusines, a class of marine alkaloids of biological significance and asymmetric synthesis of 3,3′-diindolyl methanes. The objective also included the synthesis of some analogues of these alkaloids.

Salient Features

As per objective, synthesis of some very close analogues of (±)gelliusine F, (±)gelliusine E, and total synthesis of 2,2-di(6´-bromo-3´-indolyl)-ethylamine were achieved.



R=Br, OH, R=H
Analogues of gelluesine F & E



2,2-di(6´-bromo-3´-indolyl)-ethylamine

International Collaboration	**New Advances in the integrated Management of food processing wAste in India and Europe: use of Sustainable Technologies for the Exploitation of by- products into new foods and feeds (NAMASTE)**
PI- Mr P K Goswami Dr (Mrs) Aradhana Goswami, (WP Leader 2) Dr P K Chowdhury, (WP Leader 3) Members Mr N C Gogoi Dr Dipul Kalita Dr Prakash Jyoti Saikia Mr Ananta Sharma Mr Tobiul Hussain Ahmed ***Indian Collaborating Institutions*** Euro India Research Centre, Bangalore University of Agricultural Sciences Bangalore Nature Fresh Logistics, Pune Vaigai Industries (India) Ltd., Madurai ***European Collaborating Institutions*** Institute of Food Research, UK AZTI Tecnalia, Spain Campden & Chorleywood Food Industry Development Institute Hungary, Hungary Wageningen,Food&Biobased Research, Netherland Grupo Leche Pascual, Spain J. RETTENMAIER & SÖHNE GmbH & Co. KG Germany Funded by: DBT, New Delhi	**Objective** Strategic: Interface the complementary and synergic needs and expertise of EU and India and to exploit common, industrially-driven, innovative and sustainable processes for converting locally abundant common/complementary fruit and cereal processing by-products into new food products and feed products of local and transnational interest. Research and technological development: Namaste aims to develop and assess EU-India common protocols in processing of cereal bran and fruit by-products thereby developing environmentally and economically sustainable valorized new food and feed. **Salient Features** Protocol has been developed for stabilization and preservation of rice bran, Extraction of natural colour (anthocyanin), dietary fiber and their characterization. Characterization of stabilised rice bran and the ingredients exploited from it for their suitability for application in new food and feed was completed. These includes estimation of micronutrients, protein and essential elements. Further to these the required analysis of rice bran about the presence of heavy metals, pesticide residues, microbial contamination, toxicity etc was also done. Preparation of new food and feed by using ingredients from rice bran and mango, pomegranate processing by products were in progress in collaboration with University of Agricultural Science, Bangalore.
International collaboration under CSIR-ASCR Bilateral programme	**Preparation and Application of Immobilized Esterases(/enzymes) for industry and biosensors**
PI- Dr Swapnali Hazarika Member Dr MM Bora Mr S Borthakur Funded by: CSIR, New Delhi	**Objective** To Prepare Immobilized Esterases (/enzymes) and its application for industry and biosensors **Salient Features** Novel methods for preparation of immobilized enzyme and Cross Linked-Enzyme Crystal (CLEC) was developed and relevant properties of the Immobilized / CLEC was evaluated. Kinetics and mechanism of immobilized and CLEC enzyme was established. Use of enzyme successfully demonstrated for esterification and transesterification reaction of ibuprofen and propranolol. The enzyme system was also shown to be effective for resolution of Ibuprofen and propranolol.

B) National

i) NMITLI Project

NMITLI	Genetic improvement of *Jatropha curcas* for adaptibility and oil yield
PI - Dr S P Saikia Funded by: CSIR, New Delhi	**Objective** Identification of superior plant type **Salient Features** A large number of accessions (181) acquired from different bio-geographic regions of the country, were maintained in germplasm bank. After a preliminary screening, some accessions (18) were evaluated in a R&D trail with three replications. Of these, five best accessions have been assorted on the basis of the seed yield and oil content at fifth year

ii) Suprainstitutional project

Suprainstitutional	Seismic hazard-risk evaluation & earthquake precursor related studies
PI - Dr R Duarah Funded by: CSIR, New Delhi	**Objective** ● Integrated network of both sensitive and strong motion seismographs for earthquake monitoring and precursor studies to meet the long-term challenges of predicting rupture behaviour in rocks ● Constant geodetic monitoring of crustal blocks to measure relative plate movement and stress pattern ● Adoption of practical micro-zoning procedures and improvement in modeling strong ground motion by inclusion of field observation data ● Development of strategy plan for seismic hazard reduction and application of scientific knowledge, proven engineering and educational techniques toward disaster mitigation. **Salient Features** ● Routine processing and computation of the North East Wide Area Seismic Network (NEWSN) data to define and update earthquake activity along major tectonic lineaments, and source zones. ● Studies related to changes in seismicity rate & trend, seismic quiescence and swarm, b-value, d-value, Vp/Vs to identify precursory phenomena for different tectonic blocks ● Use of accelerometer data in simulating strong ground motion characteristics – peak ground acceleration (PGA), velocity, displacement and attenuation behaviours for site specific critical design. ● Depth of the Conrad and Moho discontinuities in seismically active Shillong-Mikir Plateau ● Neotectonics & delineation of shallow sub-surface lithology using Ground Penetrating Radar (GPR). ● Delineation of active tectonic lineaments in the Sikkim Himalaya and Meghalaya Plateau. ● Setting up of permanent GPS (Global Positioning System) network to monitor rate and direction of crustal plate movement and seismic activity. ● Studies on Seismic Site Amplification behaviour and shallow sub-surface lithology for greater Agartala, Tripura.

	Seismic Site Amplification and shallow sub-surface lithology for Agartala city (N23.70˚ – 23.95˚; E91.24˚ – 91.32˚), and its suburbs cover 120sq km were studies as a part of the Seismic Microzonation program. For this purpose, short period, 3 component weak motion sensors and 3 channel seismic recorders were deployed to acquire ambient noise at 1.0 – 1.5km grid interval covering an area 120sq km. The accepted Nakamura (1989) H/V Spectral ratio technique was used to calculate the site response factor, and finally prepare the ground amplification contour map. It was observed that the site factor (H/V spectral ratio) varies in between 0.4 – 3.5 times within the predominant frequency range of 0.6–5.6Hz. The maximum ground amplification of 3.0 – 3.5 times was observed at 0.6 - 0.8Hz in case of soft soil, whereas the values range in between 1.2 – 2.0 times at 3.0 – 4.0Hz for hard and compact ground. The H/V site response factors for all well constrained measurements were plotted to prepare the peak ground amplification and predominant frequency contour maps to observe the influence on local geology and site conditions. The experimentally derived peak ground amplification and corresponding predominant frequencies were found to be in concurrence with that of the empirical values derived from geotechnical (SPT) data. The H/V spectral amplification derived for strong motion S wave portion shows close similarity with that of the H/V spectral shape derived from ambient noise. The ID shear wave velocity model of shallow sub-soil horizon was constructed through inversion of H/V resonant frequency and H/V ellipticity curves. The Ground Penetrating Radar (GPR) survey was conducted to delineate the shallow sub-surface structures and neo-tectonic signatures in all accessible areas including the City suburbs. The data contains a survey length of total 32km recorded in several N-S and E-W profiles. It was observed that the upper soil horizon within the 3.0 – 8.0mt depth range is a highly deformed silty-sand layer, and it persists throughout the built environment of the city. Below this silty-sand horizon, the impervious clay layer extends up to a depth of about 16m. The available information was incorporated to prepare the microzoning maps helpful in hazard zoning, land use and urban development.
Suprainstitutional	**Utilization of medicinal, aromatic and economic plants for industrial; and socio economic upliftment of North-East India**
PI- Dr P R Bhattacharyya Members Dr S C Nath Dr M Borthakur Dr S P Saikia Dr B S Bhau Dr M Bhuyan Dr P Baruah Dr A K Bordoloi Funded by: CSIR, New Delhi	**Objective** Agro-technology Development and socio-economic upliftment **Salient Features** ● Success in fruiting of Shiitake (*Lentinula edodes*) cultivation by using Synthetic substrate inoculated by pure culture, wood peg spawn and paddy spawn respectively under laboratory condition. The biological efficiency of 60-70% was obtained in 70-80 days of cropping period. ● Success in fruiting of *Ganoderma lucidum* cultivation by using Synthetic substrate inoculated by pure culture under laboratory condition. The biological efficiency of 64-80% was obtained in 65-70 days of cropping period. ● Protocol for in - vitro large scale multiplication and lab to field transfer of *Curcuma* aromatic, locally known as Ban Haldi has been established. Protocol showed simultaneous regeneration of shoots

	and roots and thus escaping one step (root induction) separately. The plant has got vast ethno-botanical value and exerts various medical activities like carminative, antidote to snake bite, astringent, as tonic and promotion of blood circulation to remove blood stasis, treating cancer etc. Moreover it contains several anti-tumor active ingredients. Our established mass multiplication protocol can be suitably utilized for large scale plantation for bulking up of materials for economic return. ● In–vitro regeneration of *Closena heptaphylla* from a Chemo-type source, has been established. Attempt made for this plant species is seems to recorded first. This particular chemo-type contains methyl chavicol 75% and 86% from it's total leaf and fruits oils respectively. Anethole is also obtained in 22% and 12% from leaf and fruit oils respectively. Being a perennial plant once established, cultivation and maintenance it will be profitable one where for elite multiplication plant tissue culture is highly justified & demanding.

iii) Facility Art Creation

FAC	State of Art analytical facility for North East
PI - Dr NC Barua Members - Dr PK Chowdhury Late Dr JC Sarma Dr Manabjyoti Bordoloi Dr Dilip Kr Dutta Dr (Mrs) AM Das Funded by: CSIR, New Delhi	**Objective** ● Testing the bioactive principles present in herbal and plant resources and for food product analysis. ● Screening of herbal and plant resources of north east by testing the herbal or plant material for nutraceutical bio-principles which are responsible for enhancement of defense mechanisms, prevention of specific diseases, recovery from diseases, control of physical and mental conditions. ● Testing the herbs and plant materials for dietary fiber, oligosaccharides, sugar alcohols, amino acids, peptides, proteins, glycosides, alcohols, isoprenoids, vitamins, cholines, lactic acid bacteria, minerals, poly unsaturated fatty acids, chlorogenic acid and poly phenols (anti-oxidants) which are identified as nutraceutical compounds. ● Relating the ingredient component for the health promoting properties such as calcium for osteoporosis, sodium for hypertension, dietary fiber and cancer, folate and cancer, folate and neural tube defects, protein and coronary heart disease, phytosterols and CHD, omega 3 fatty acids and CHD etc., in case a new component with nutraceutical properties are isolated, a detailed study will be carried out. ● To provide analytical services for bioactive phytochemicals to farmers and entrepreneurs of the northeast India. **Salient Features** ● Construction of State of Art Analytical Facility building is completed. ● Acquired equipments & other infrastructure. ● Medicinal Plants investigated : 8 ● Ph.D. Supervised : 2 ● Patent filed in India : 1 ● ECF generated : 72 lakh

The identification and application of two promising pigmented varieties of rice of NE region of India as potent nutraceutical with high anthocyanin content along with dietary fiber arabinoxylan having antioxidant, anti-inflammatory and other organoleptic properties was done. Phytochemical analysis service has been provided to two medicinal plant farmers.

Front view of the facility

Analytical lab

Equipment room

Equipment room

iv) Network Projects

Network	Exploration of India's rich microbial diversity
Nodal Scientist- Dr TC Bora Members- Dr NC Barua Dr RL Bezbaruah Dr(Ms) N Saikia Dr Ratul Saikia Dr M Khongsai Mr Ajit Kakoty Ms Archana Yadav Project Asstt: Level II – 4 Nos. Funded by: CSIR, New Delhi	**Objective** ● Collection of samples such as soil, water, barks of trees from NE Indo-Burma Region. ● Isolation of 500 microbial strains per year from various ecological niches of Indo-Burma hot zone and their bioevaluation at NEIST, Jorhat for new bioactive, targeted and potential enzymes and their maintenance at Culture Deposit centre and exchange with CSIR labs. ● Screening for 'Enzyme Tool Box': Nitrilase, Hydroxylase and Epoxidase. ● Biotransformation of: Sertraline, 4'-oxo-A vermectin and Doxazosin ● Taxonomic characterization of new taxon and maintenance of cultures as stock cultures. **Salient Features** ● Isolated 3000 strains annually from environmental samples collected from various ecological niches of North East.

- Preserved and maintaining 4000 strains in pure culture condition using standard protocol scientifically, as stock cultures as a precious and indigenous bioresources of NE Gene pool.
- Screened a good number of strains for bioactives molecules, bioassayed and short-listed for further experiments.
- Screened for targeted enzymes and developed Enzyme Tool Box for industrial application.
- Supplemented novel bacterial genus and species from North East gene pool into world microbial taxonomy.

Network

Biological and chemical transformation of plant compounds for production of value added products of therapeutic/aroma value

Nodal Scientist-
Dr NC Barua

Members-
Dr PK Chowdhury
Late Dr JC Sarma
Mr P Borkakoti

Funded by:
CSIR, New Delhi

Objective

Chemical transformations

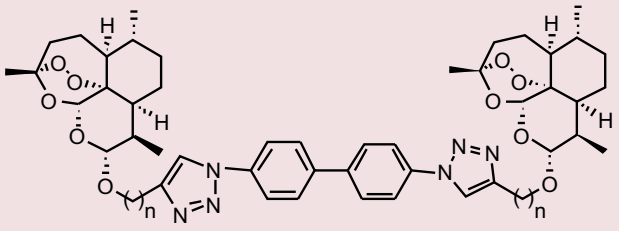
- To transform natural Artemisinin to novel Artemisinin dimers chemically
- To bioevaluate the newly synthesized molecules for antimalarial activity against chloroquin resistant strains of malaria parasites
- To test these compounds for anticancer activity
- To synthesize new peptide-steroid conjugate
- To evaluate these compounds

Biological Transformations

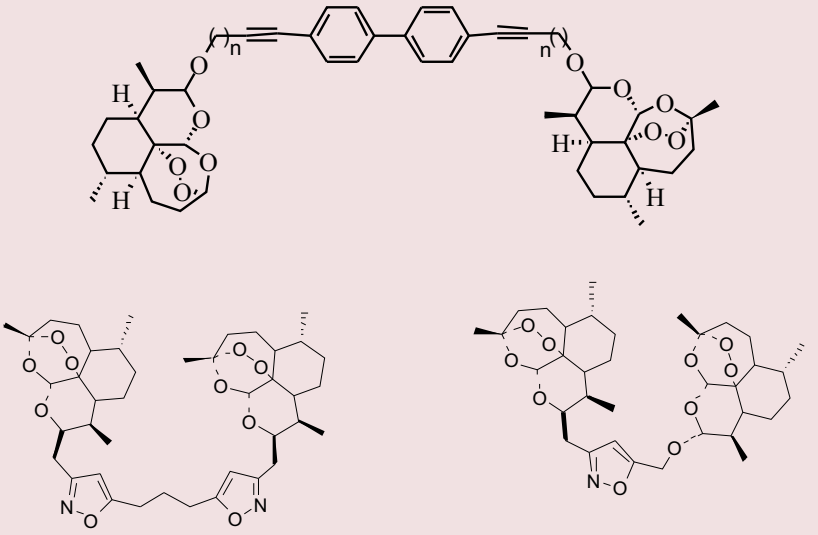
- Immobilization of genetically transformed microbial cells containing GTase/ATT in different solid matrix will be done. The culture will be supplied by CIMAP
- Biotransformation of selected phytopharmaceuticals, e.g. Asiatic acid and betulinic acid will be carried out
- Isolation and characterization of biotransformed products.

Salient Features

The anticancer and anti malarial bioassay of the two artemisinin dimmers were done at IIIM and RMRC Dibrugarh respectively. Although the anticancer efficacy of these molecules against several cancer cell lines was very good, the anti malarial efficacy was found to be not much superior to artemisinin. A patent document entitled " A Novel series of 1,2,3-triazole containing artemisinin derived dimmers with potent anticancer activities" was filed in India & PCT countries. A new steroid peptide conjugate was synthesized which would be bioevaluated. A joint collaborative work on Ginseng cell culture was carried out jointly with CSIR-CIMAP, Lucknow.. A new ginseng culture was received from CSIR-CIMAP which was maintained at CSIR-NEIST. This cell line produced an edible natural colouring material. This cell line was proposed to be up scaled in bioreactor for extraction of this natural dye.



n = 1 (40%)
n = 2 (40%)



Few representative artemisinin dimmers with promising anticancer activities synthesized

Network	Development of specialty inorganic materials for diverse applications
Nodal Scientist- Dr Dipak Kumar Dutta Activity A PI- Dr Rajib L Goswamee Members- Mr D Bordoloi Mr Madan Gopal Pathak (Retd) Dr RK Baruah Mr RC Borah Mr Paran Phukan (Retd) Activity B PI- Dr Dipak Kumar Dutta Members- Dr Pinaki Sengupta Dr Lakshi Saikia Dr Pooja JA Rao Mr Madan Gopal Pathak (Retd) Funded by: CSIR, New Delhi	**Objective** Nano-Inorganic materials for catalysis, adsorption and preparation of nanocomposites **Activity A** ● To design and prepare some novel oxidic absorbents/catalysts from composites of anionic and cationic clays, supported and coated on some ceramic substrates. ● To study the effectiveness of these coated substrates to treat environmentally harmful gases like SO_2, H_2S, N_2O, NO_X etc. ● To study the regeneration / reusability of these oxide coated ceramic substrates. **Activity B** ● Development of processes for in situ generation of selected metals (Platinum, Nobel and Transition metals groups) nanoparticles in different specific sized fractions in the range 0 – 100 nm size. ● In situ generation of metals nanoparticles (below 100 nm size) into interlamellar spacing of layered matrix of clay and others and also on the surface of suitable supports. ● To prepare Clay nano-composites useful as solid acid catalysts. ● Evaluation of the supported Nanoparticles composites in the area of catalysis (Esterification, Hydrogenation, Oxidation, etc.), Antimicrobial activities etc. **Salient Features** **Activity A** Reaction of Gases with supported oxides derived from composite LDH: Designed and fabricated stainless steel catalytic converter to house supported honeycombs for carrying out gas solid reaction. Gas-solid reaction on decomposition of N_2O in presence of Argon over calcined Ni-Al LDH, composites containing clay & LDH reactor bed at 450-500°C in quartz

reactor was carried out and standardized protocol for analysis of reactants and products by Gas Cell IR and Gas Chromatograph.

Synthesis and coating of silica supported Nickel Oxide particles over ceramic pre-forms through sol-gel derived layered double hydroxides: Silica supported nickel oxide fine particles have been synthesized through sol-gel derived Ni-Al Layered Double Hydroxide (LDH) and coated over honeycomb ceramic pre-forms through dip-coating technique. The SEM patterns of coated supported suspensions over ceramic substrates show formation of thin and crack free coats of particles (Fig. 1).

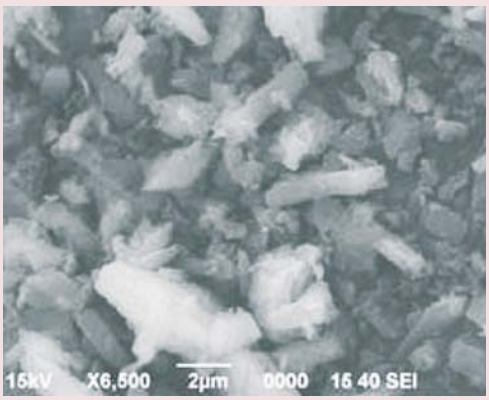


Fig. 1: SEM pattern after coating upon honeycomb pre-form and calcined at 450°C

Activity B

Synthesis of Ni^{o}-nanoparticles on nanoporous clay matrix and catalytic transfer hydrogenation reaction: Ni^{o}-nanoparticles of 0-8 nm were prepared in situ by impregnation of $Ni(CH_3COO)_2$ into the nanopores of modified montmorillonite followed by polyol reduction and characterized by TEM (Fig.2), XRD (Fig.3) etc.

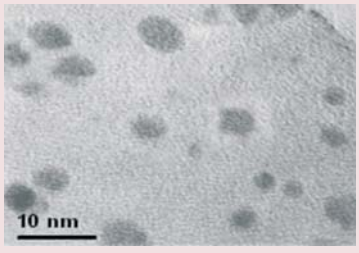


Fig. 2 : TEM images of Ni^{o}-nanoparticles

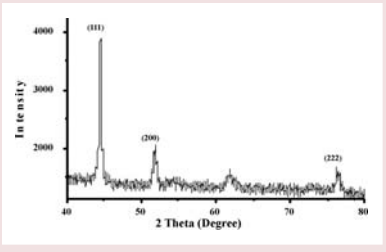
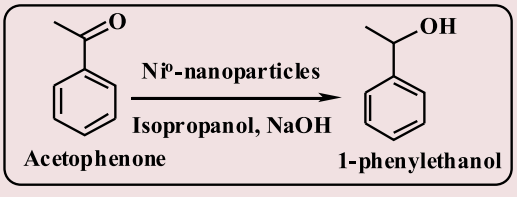


Fig. 3 : XRD patterns of Ni^{o}-nanoparticles

These supported Ni^{o}-nanoparticles showed efficient catalytic activity in transfer hydrogenation of acetophenone to 1-phenylethanol (Scheme: 1) with about 98 % conversion, having nearly 100 % selectivity (Fig. 4).



Scheme 1: Transfer hydrogenation reaction in presence of Ni^{o}-nanoparticles

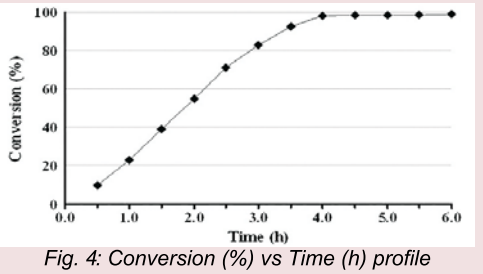
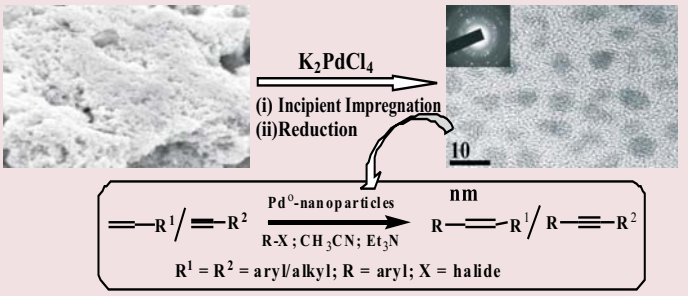


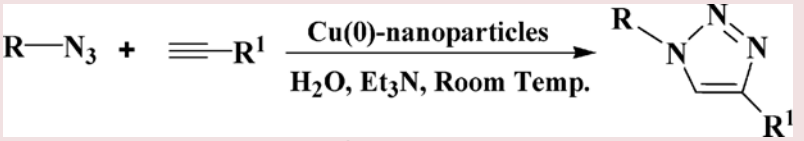
Fig. 4: Conversion (%) vs Time (h) profile

Generation and in situ stabilization of Pd°-nanoparticles into modified Montmorillonite: An efficient heterogeneous catalysts for Heck and Sonogashira coupling reaction: In-situ generation of Pd° nanoparticles into the pores of modified Montmorillonite and their catalytic performance in C-C bond formation reaction namely Heck and Sonogashira coupling reaction were carried out (Scheme 2). The nanocatalysts could be recycled and reused several times without significant loss of their catalytic activities.



Scheme: 2

Stabilization of Cu(0)-nanoparticles into the nanopores of modified montmorillonite: An implication on the catalytic approach for "Click"reaction between azides and terminal alkynes: In situ generation of Cu(0)-nanoparticles in the nanopores of modified montmorillonite and their catalytic activity in 1,3-dipolar cycloaddition reactions between azides and terminal alkynes to synthesise 1,2,3-triazoles were carried out (Scheme: 3). The nanocatalysts could be recycled and reused several times without significant loss of catalytic activity.



Scheme: 3

Ru°-nanoparticles-Montmorillonite for chemoselective transfer hydrogenation Reduction: Ru°-nanoparticles of approximately 5 nm size (Fig. 5) were generated into the nanopores of the acid activated Montmorillonite clay. The Ru°-nanoparticles exhibit efficient catalytic activity in the chemoselective transfer hydrogenation reduction of substituted nitrobenzenes to corresponding anilines with high conversion (56 - 97%) and selectivity (91 – 99 %) (Scheme: 4).

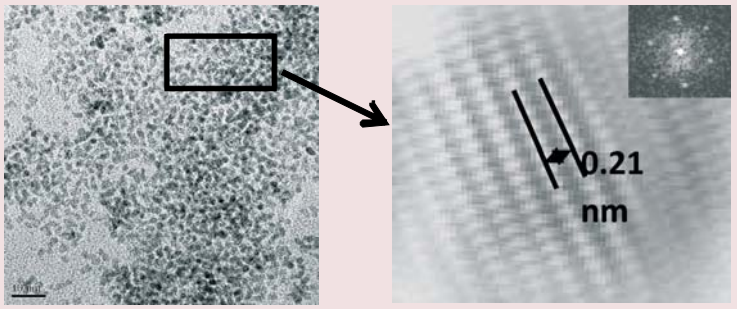
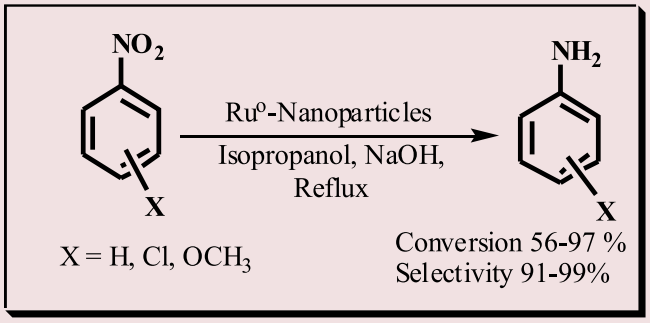


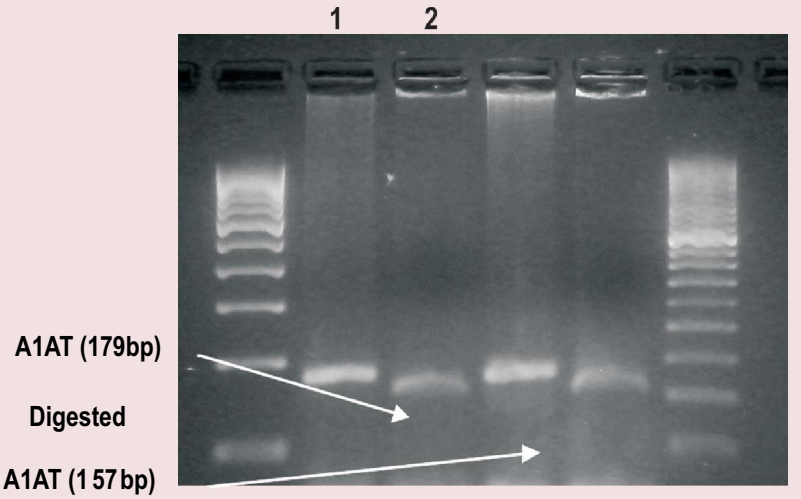
Fig. 5: HR-TEM images of Ru^{o}-nanoparticles



Scheme: 4

Network	**Environmental contaminants: new screening technologies and effect on human health**
Project Coordinator- Dr PG Rao Nodal Scientist- Dr BG Unni Members- Dr (Ms) Kiran Tamuly Dr PK Baruah Dr T Borah Mr RC Bharali Dr NC Dey (Retired) Dr SB Wann Mr OP Sahu Ms Lakhimi Bora Funded by: CSIR, New Delhi	**Objectives** Alpha 1 antitrypsin gene: a case-control study in chronic obstructive pulmonary disease **Salient Features** Alpha-1 antitrypsin (AAT) deficiency is an inherited disorder that causes low levels of, or no alpha-1 antitrypsin in the blood. The most common illness in adults with alpha 1 antitrypsin deficiency is lung disease during the third and fourth decades of life. Most commonly it is associated with chronic obstructive pulmonary disease (COPD). Mutations in the PI gene, located on chromosome 14, are associated with this genetic disorder. The Z protein is due to a single amino acid substitution of 342 glutamineto lysine. Although cigarette smoking is the main environmental risk factor, only about 15% of smokers develop clinically significant disease suggesting other influences on disease expression. The study included hospital based age and sex matched 100 cases of COPD and 100 controls without COPD recruited from nearby places of Assam. These cases were recruited from February 2009 to December 2009.Subjects were included in the COPD group on the basis of lung function test.DNA extraction was done by DNA extraction kit and amplification for Alpha-1-antitrypsin gene was done by site directed mutagenesis PCR method as described by (Tazellar et al,1992). Statistical analysis was carried out using chi-square test for categorical variables and Students t-test for continuous variables. Data were tabulated and classified as per the age, sex, smoking and lung function status. Chi-square test with Yates correction was applied to test significant difference in the number between smoker and non-smokers, males and females amongst COPD and

Non-COPD subjects. Unpaired 't' test was applied to test for significant difference in smoking (pack-years), age, and lung function amongst the COPD and Non-COPD subjects. In the entire study, it was found that smoking was the prior cause of COPD and A1AT deficiency is not prevalent in the population subset. In addition to this, our study reveals that other genes besides A1AT (ZZ type) could be responsible for the prevalence of COPD. Moreover, COPD is polygenic and prevalence rates are different in different ethnic groups. Worldwide, the ZZ carriers are mostly found in the Caucasians of European ancestry (Povey, 1990). PCR amplification showed characteristic 179bp band (Fig.1) indicating the presence of homozygous 'MM' type in all the samples. On restriction digestion, a band was observed at 157bp in all the samples. As such, there was no ZZ mutation in these subjects in their A1AT gene. Since all the samples were homozygous 'MM' type, our data did not fit the 'Hardy-Weinberg equation'. Sequencing of the A1AT gene also agreed to the findings of PCR and Restriction enzyme analysis. The sequences obtained were aligned with the mRNA of normal (MM type) Alpha-1-Antitrypsin gene No difference was found in position Glu342 GAG Lys AAG in COPD smoker, COPD Non-Smoker, Non-COPD Smoker and Non-COPD Non-smoker respectively.



Detection of A1AT gene by site directed mutagenesis PCR method .Lanes 1, 2 A1AT gene179bp normal (MM type). The primers used to amplify the sequence that included the Z mutation site yielded a product of the correct size (179 bp) in all cases. Subsequently, PCR products were digested with Taq I enzyme. The normal fragment was 157 bp long.

Most of the people studied were of tribal community belonging to Mongoloid origin and as such they were different from the rest of the Indian population. We found that smoking was the prior cause of COPD. A1AT deficiency is not prevalent in our population subset but certain other genes could be the attributable factor for COPD. Further studies needed to be carried out to investigate individual susceptibility to COPD due to genetic factors or other environmental reasons such as air pollution, occupational exposure, etc.

Network	Development of advanced eco-friendly, energy efficient processes for utilization of iron ore resources of India

PI-
Dr S Mahiuddin

Members-
Dr P Sengupta
Dr MR Das
Mr D Bordoloi,
Mr Ajit C Baruah
Dr HP Deka Baruah
Dr Rajani K Baruah

Funded by:
CSIR, New Delhi

Objective

To develop a comprehensive and appropriate beneficiation and utilization strategy for low grade Indian iron ores, fines and tailings for effective utilization in iron and steel making. The basic objective of the project is to reduce the gangue materials in various low grade iron ores containing around 58-52% Fe by suitable advanced beneficiation techniques for complete utilization in the most cost effective way. Another aim is to utilize all the wastes generated during processing for value addition. The concept is the zero waste technology by processing the low grade ores, fines and slimes. CSIR-NEIST Jorhat objective: Beneficiation of low grade iron ore fines and slimes Utilization of beneficiation wastes for value addition

Salient Features

Humate in the presence of 1 to 5% hard water produces a stable suspension for slime and fines and can be used for further beneficiation and subsequent recovery of iron value.

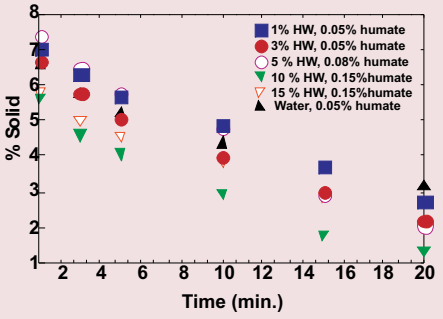


Fig. Stability of dispersed phase of iron ore slime (10 % solid) at different hard water concentration

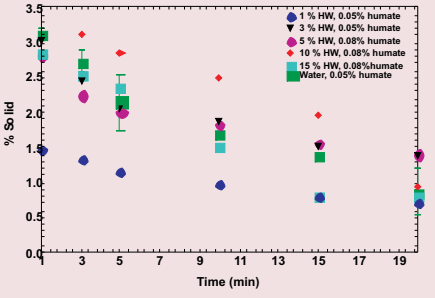


Fig. Stability of dispersed phase of Fines-I (25 % solid) at different hard water

Natural hard water was used at different concentration for flocculating/settling of particles/gangue minerals in the dispersed phase for generating clean water for subsequent preparation of stable dispersed phase using iron ore fines and slime and surface-active agent. A typical snap-shot is given in Fig.

Fig. A typical snapshot showing (a) dispersed phase (b) flocculation/settling of suspended particles in 1% DP of slime slurry in the presence of natural hard water and (c) stable dispersed phase of 25% iron ore fines using water from 0 and 0.05% humate.

Network	Discovery and preclinical studies of new bioactive molecules (natural and semi-synthetic) & traditional preparations
Coordinator- Dr NC Barua PI- Dr J C Sarma Member- Dr RC.Borah Dr DK Dutta Dr PR Bhattacharya Dr SC Nath Dr PK Chowdhury Dr MJ Bordoloi Dr AM Das Dr G Baisya Funded by: CSIR, New Delhi	**Objective** a) To develop an optimized process for production of a tea pest controlling agent from a naturally available plants b) Extraction of selected medicinal plants of North East India, bioevaluation of the extracts against identified diseases & pests in different sister CSIR labs, Fractionation of the extracts based on recommendation of the Central APEX committee, Chemical profiling of the active fraction(s), Bioevaluation of the isolated pure molecules to find out the bioactive molecule, IPR protection, Product development as drug/pest control agents **Salient Features** a) A naturally available pest control agent (Bioactive molecule) from the leaves of a plant has been extracted from the leaves of a locally available plant (a much branched deciduous spine scent shrub). It was found to kill the pest like red spider mite responsible for destroying the tea leaves. Process developmental work was done for optimization of process at a 1Kg of product per batch scale. Various process developmental steps such as extraction, filtration and solvent recovery were optimized. Several problems such as solvent recovery and drying of the product were solved. Field trial of the bioactive molecule was done at the tea gardens of Tocklai tea experimental station after formulation with the help of a drugs formulating agency. For large scale field studies large amount of the product was generated at pilot plant. A Process Know-How package of the process was prepared. b) One extract RJO/2355/P03/A001 has shown promising activity (90-95%) against tea pest in small scale field trial experiment. In collaboration with Institute of Pesticide Formulations and Technology, Gurgaown the extract was formulated in pilot plant. The formulated extract (25lits) of the same was handed over to Tocklai Experimental Station, Jorhat for multipositional large scale field trial experiment. The field trial data were positive. The knowhow package of the herbal pest control agent was prepared.

Network	TKDL Project
PI- Dr SC Nath Funded by: CSIR, New Delhi	**Objective** Digitalization of plant database **Salient Features** Documentation of data records covering 5000 recipes of plant folk medicines represented by 1000 plant species under 120 secondary literatures from North-East India using TKDL software have been completed and provided to the Nodal lab i.e. TKDL, CSIR for integration into the TKDL database

Network	Enhancement and up gradation of testing and calibration facility to broader areas of testing and calibration for a high quality testing and calibration laboratory setup in NE region
PI - Dr P C Sarmah Member- Mr K Buragohain Mr P Baruah Mr Chandan Boruah Funded by: CSIR, New Delhi	**Objective** i) To establish a full-fledged Testing and Calibration laboratory in different areas of measurement in NE Region of India. ii) To cater to the need of Testing and Calibration for various organisations, research institutes, Govt. Agencies, Universities etc. of NE Region. iii) To include more areas of Testing and Calibration. iv) Service to be offered to different educational institutes of NE Region and training on this subject. **Salient Features** i) A laboratory for Testing and Calibration was set up for measuring equipments relating to electrical parameters (current, voltage, resistance etc.), pressure and temperature. ii) Calibration works for laboratory's equipments were carried out. iii) Training on maintenance, handling and operation of Multi-product Calibrator was provided to a number of students and departmental staff.
Network	**Rural development through aromatic plant cultivation and mushroom processing in North-East India.**
PI- Dr PR Bhattacharyya Members- Dr SP Saikia Dr M Bhuyan Dr P Baruah Dr AK Bordoloi Funded by: CSIR, New Delhi	**Objective** Rural development of North-East India **Salient Features** Aromatic Plants cultivation was extended to an area of 107 ha and 2 processing units were established at Singgat village. Chhurachandpur District and Nungba, Tamenglong District of Manipur. Two Mushroom production units were established at Karbi-Anglong, Assam, Agartala, and Tripura. 22 training programs were conducted on mushroom and aromatic plant cultivation. Lab scale trial was completed for one technology on value addition of North-East Germ Plasm for controlling storage insect Pest

PROGRESS OF GRANT-IN-AID, INHOUSE, CONSULTANCY PROJECTS

Agrotechnology

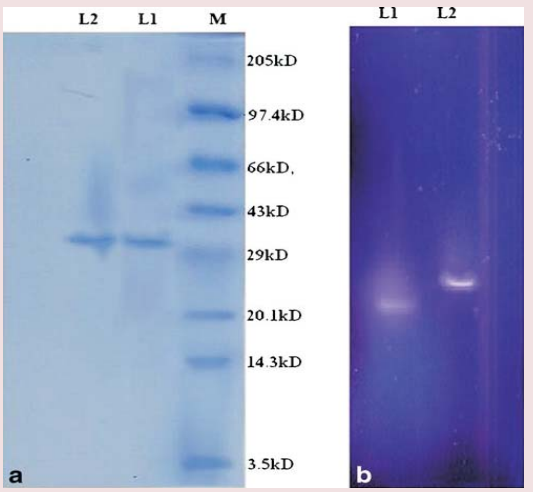
GAP	Antifungal activity of hypomycetes fungi distributed in the alluvial soils of upper Brahmaputra valley of Assam
PI- Dr P Baruah Funded by: DST, Govt. of India	**Objective** Microbial Studies **Salient Features** Altogether 41 species of Hyphomycetous fungi were isolated from the alluvial soils of Upper Brahmaputra valley of Assam. Among the isolated species, four of them showed promising antifungal activity against plant pathogens. The antagonists namely *Trichoderma harzianum, Chrysosporium phaenerochaete, Gliocladium roseum* and *Penicillium citrinum* showed activity against *Verticillium dahliae, Fusarium oxysporum* and *F. solani* causing vascular wilt in Brinjal, Dahlia and Chilli plants respectively.
GAP	**Studies on butterfly and insect pest fauna of three watershed areas of eastern India.**
PI- Dr M Bhuyan Member- Dr PR Bhattacharyya Funded by: DST Govt. of India	**Objective** Faunal Studies **Salient Features** Sakchi Kho watershed Kalaktang area of Arunachal Pradesh is located between 26.066N-27.100N latitude and 92.550E-92.583E longitude and at altitude from 200 m to 1500 m comprising 369.77 ha. Five distinct habitats i.e. grassland, woodland, rocky, agricultural land and riparian habitats was identified in the watershed area. Butterflies were surveyed through line transect.70 species of butterflies were recorded at the watershed. Of these Nymphalidae was found to be the dominant family then Pieridae and Papilionidae, in contrast to Lycaenidae and Hesperiidae which were scarce. Diversity indexes were also worked out. The availability of these butterflies indicates that the watershed possesses larval and nectar host plants of all those butterflies. In future, systematic study and taxonomical description of unexplored butterfly host plants will be studied. The study would help to establish a fruitful indication of the health and status of the watershed as well as to strategize a comprehensive plan for management and conservation of baseline ecological aspects of the watershed through butterfly indicator for future.
GAP	**Diseases and insect pests of ginger and turmeric in North-east India**
PI- Dr PR Bhattacharyya Member- Dr P Baruah Funded by: DBT, Govt. of India	**Objective** Plant Protection Studies **Salient Features** Major diseases of ginger recorded were rhizome rots of ginger caused by *Fusarium solani, F. oxysporum* & *Pythium* sp. Insect pests of ginger were

	found to be Cigarette Beetle- *Lasioderma serricorne* and drug store beetle- *Stegobium paniceum*. Major diseases of turmeric recorded were rhizome rots of turmeric caused by *Pythium* sp. & *Aspergillus flavus*. No significant insect attack on turmeric rhizomes was recorded. Experiment showed that maximum damage was done by *F. solani* followed by *Pythium* sp. and *F. oxysporum* in ginger rhizomes whereas maximum damage to turmeric rhizomes was done by *Pythium* sp. than by *A. flavus*.
GAP	**DNA Clubs DBT-TERI mentoring schools of northeast**
PI- Dr HB Singh Funded by: DBT, New Delhi	**Objective** Creation of laboratory facilities and training, education and awareness on bioresources **Salient Features** ● Laboratory equipments were created in 57 schools of Manipur. The equipments distributed to 57 DNA Club Schools of Manipur by Shri O Ibobi Singh, Hon'ble Chief Minister, Manipur includes (i) Compound microscope (570 nos.) (ii) Dissection microscope (114 nos.), (iii) Computer sets along with lazer printer (114 nos.) (iv) Digital camera (57 nos.), (v) Refrigerator (57 nos.), (vi) Herbarium press-field model (57 nos.), (vii) Herbarium press-lab model (57 nos.) (viii) Herbarium cabinet (57 nos.) (ix) Binocular (57 nos.). Magnifying lens (57 nos.) (x) Weighing balance (57 nos.). ● A Radio serial having 10 episodes based on DNA Clubs established-sponsored and broadcasted from All India Radio, Imphal on every Sunday at 6.40 am on 18/12/11, 25/12/11, 1/1/12, 8/1/12, 15/1/12, 22/1/12, 29/1/12, 5/2/12, 12/2/12 & 19/2/12. ● Conducted / demonstrated laboratory experiments to teachers and students on (i) Compost making (ii) Nursery raising (iii) herbarium making (iv) DNA extraction from plant materials. ● Organized Spot painting & Essay writing competitions on the topic "Biodiversity conservation" on 19/4/2011. 114 students participated and prizes were distributed to winners.
GAP	**Bio-prospecting of wild edible plants for socio-economic development in Manipur state North-eastern India**
PI- Dr Alka Jain, Women Scientist Funded by: DST, New Delhi	**Objective** Bio-prospecting of edible plants **Salient Features** Process/Technology developed: Developed 2 spices products based on traditional spices plants of Manipur (i) Yummy Queen (Veg) – for vegetable cuisines and (ii) Yummy Queen (Non-Veg) – for non-veg cuisines. These two products were ready for release. 

GAP	Development of herbal garden inside the Kangla fort, Imphal
PI- Dr HB Singh Funded by: Govt of Manipur	**Objective** Establishment of a herbal garden inside the Kanga Fort, Imphal **Salient Features** ● Cultivated 191 plant species like *Aquilaria agallocha, Azadirachta indica, Michelia champaca, Bombax malabathricum, Phyllanthus acidus, Phyllanthus emblica, Oroxylum indicum, Garcinia morella, Sapindus mucrotanus,* etc. ● Cultivated 1200 slips of Lemon-grass (*Cymbopogon citratus*)
Inhouse	**Exploration & utilization of medicinal & economic plants of Arunachal Pradesh through development of agro technology and chemical investigation**
PI- Mr CTamuly Members- Dr BC Baruah Mr J Bora Ms M Hazarika Funded by: CSIR, New Delhi	**Objective** ● To introduce various medicinal aromatic and economic plants. ● To develop new/better strain of medicinal /aromatic plants and explore the possibilities for commercial cultivation. ● Chemical investigation and evaluation of biological activities of unexplored or under-explored medicinal and economic plants of Arunachal Pradesh. ● Identification of new/better source of aroma chemicals, fat, dye, natural fibre, nutraceuticals, drug and drug intermediate for industrial utilization. ● To generate knowledge, enhance the value of knowledge and its application for agro based industrial development in the rural sector ● To generate employment opportunities for socio economic uplift in the rural sector. **Salient Features** Development of new strain : A new strain of lemon grass (BLI-ARUN) was developed. An approach was taken to increase the oil content of BLI-ARUN strain of lemon grass through chemical mutation breeding technique. About 25-35% increase of essential oil content was achieved having 1.6-1.8% of essential oil. Evaluation of nutraceuticals, bioactive comps, biological activities of isolated comps & plant extract : Ten nos. of ethno-medicinally use wild edible plant selected and nutraceuticals were evaluated Evaluation of antioxidant activities : Antioxidant activities, phenolic content, flavonoid content were evaluated for ten nos. of medicinal and edible plant. The antioxidant activity was analyzed by DPPH, FRAP, ABTS, hydrogen peroxide, hydroxyl radical, reducing power, chelating power assay. The antioxidant activity (AOA) value was expressed as equivalent concentration at 50% inhibition (EC_{50})in microgram/ml Evaluation of mineral content : The minerals i.e. K, Na, Ca, Fe, Cu, Mg, Mn, P, N, Pb, Mo and As were evaluated for ten nos. of edible plant of Arunachal Pradesh

Inhouse	**Study on nutraceuticals, phytochemicals and medicinal properties of a few *Piper* species of North East India**
PI- Mr C Tamuly Funded by: CSIR, New Delhi	**Objectives** a) To evaluate nutraceuticals from different parts of selective *Piper* species of North East India. b) Chemical profiling of secondary metabolites like alkaloids terpenoids, flavonoids etc of different parts of the selective species. c)To evaluate the antioxidant properties, polyphenols & flavonoids content of the selective *Piper* species. **Salient Features** i) Synthesis of Ag & Au nanoparticles: The Ag and Au nano particles were synthesized by using isolated compound purified from leaf of *Piper pedicellatum* C.DC. It was confirmed by XRD, UV-VISIBLE analysis. From the TEM analysis it was found that Ag, Au and Ag-Au nanoparticles was formed and size range 3-50nm, 2-70nm and 5-80nm for Ag, Au and bimetallic Ag-Au nanoparticles respectively. ii) Presented a paper entitled "Synthesis of Ag and Au nano particles using *Piper pedicellatum* C. DC: A green Chemictry Approach" authored by Chandan Tamuly, M. Hazarika, Sarat Borah, M. R. Das in a National Symposium on "Recent trend in Chemical Science & Technology" held at IIT Patna on 3-4th March'2012. iii) Evaluated antioxidant activity of five piper species by using different assays collected from North East India. iv) C.Tamuly, M. Hazarika, J. Bora & P.R.Gajurel. Antioxidant activities and phenolic content of *Piper wallichii* (Miq.)Hand.-Mazz. *International Journal of Food Properties*.
Inhouse	**Development of novel products based on ethnic designs**
PI- Dr HB Singh Coordinator- D Chandrmouli Funded by: CSIR, New Delhi	**Objective** Establishment of a resource Hub centre for ethnic Designs of Northeast **Salient Features** • Established the Resource Hub Centre for Ethnic Designs of Northeast at the NEIST Substation, Imphal equipped with digitizer, plotter-cutter and relevant software. • Developed more than 50 novel products (mainly ladies bags, travel bag, file folder, card holder, half coat, purse, etc.) based on ethnic designs and materials of northeast. Organized 2-day workshop-cum-exhibition at Imphal during Oct 18-19, 2011. • A training program on making of novel products was conducted during Oct 17-23, 2011 participated by 7 trainees. Experts from CLRI, Chennai have imparted the training.
Consultancy	**Butterfly population studies in NRL butterfly valley**
PI- Dr M Bhuyan Member- Dr PR Bhattacharyya Funded by: NRL, Numaligarh, Assam	**Objective** Augmentation of Butterfly Population **Salient Features** Research works on biology and ecology of butterflies available at NRL butterfly valley were conducted. During the period, biology of 10 butterfly species was documented. Host ranges of those butterflies were also identified. The ecology and foraging behavior of different species of butterfly were also studied

Biological sciences

GAP	Exploration and screening of bacterial diversity in North-East India and Its potential application in biocontrol
PI- Dr Ratul Saikia CoPI- Dr TC Bora Funded by: ICAR, New Delhi	**Objective** ● Collection of environmental samples from different habitant of North-East States of India ● Isolation, purification and preservation of bacteria ● Bacterial data base development for future uses ● Screening of bacterial isolates for biocontrol ● Characterization of potential isolates and diversity analysis **Salient Achievements** Phylogenetic analysis of alkaline proteinase producing fluorescent pseudomonads associated with green gram (*Vigna radiata L.*) rhizosphere Fifty fluorescent pseudomonads were isolated from rhizospheric soil of green gram from nearby area of Kaziranga, Assam, India and assayed for their extracellular proteinase production. Out of these isolates 20 were found to be prominent in proteinase production. Genetic diversity of the 20 isolates were analyzed through BOX-PCR fingerprinting and 16S rDNA-RFLP along with three reference strains, viz., *Pseudomonas fluorescens* (NCIM2099^T), *P. aureofaciens* (NCIM2026^T) and *P. aeruginosa* (MTCC2582^T).Based on phenotypic characters and 16S rDNA sequence similarity all the 8 highly proteinase producing strains were affiliated with *P. aeruginosa*. The proteinase was extracted from two most prominent strains (KFP1 and KFP2), purified by a three-step process involving $(NH_4)_2SO_4$ precipitation, gel filtration and ion exchange chromatography. The enzyme had an optimal pH of 8.0 and exhibit highest activity at 60°C and 37°C by KFP1 and KFP2 respectively. The purified enzyme was migrated as a single band on native and SDS-PAGE with a molecular mass of 32 kDa (Fig. 1). Zn^{2+}, Cu^{2+} and Ni^{2+} ion inhibited the enzyme activity. Enzyme activity was also inhibited by EDTA established as their metallo-proteinase nature.  Fig.1. SDS-PAGE (15%) of the purified proteinase from *Pseudomonas aeruginosa* KFP1 and *P. aeruginosa* KFP2; M, molecular mass standard; L1, purified proteinase of KFP1; and L2, purified proteinase from KFP2 showing 32 kDa molar mass. b. Zymography of purified proteinase; L1, zymography of KFP1 purified proteinase and L2, zymography of KFP2-purified proteinase (Sarma et. al., 2012, *Folia Mcrobiologica*).

	DNA fingerprinting of fluorescent pseudomonads associated with rhizospheric soil of green gram - role in plant growth promotion under water stress. A total of 130 fluorescent pseudomonads from green gram rhizospheric soil of Jorhat district of Assam were isolated and characterized for multiple plant growth promoting traits, such as the production of indole acetic acid (IAA), nitrogen fixation, phosphorus (P) solubilization, siderophore production, production of ammonia (NH_3) and production of different enzymes viz., protease, chitinase, pectinase and cellulase. On the basis of PGPR characteristics 8 isolates were tested for 1-aminocyclopropane-1-carboxylic acid (ACC) deaminase activity. Further in vitro studies of role of two potential bacterial isolates on water stress resistance were examined. In vivo study of these two isolates in green gram plant revealed increase in root length of 10-20% and dry weight of between 22 to 35% in comparison to the positive controls under water stress condition. Chlorophyll content as well as accumulation of proline in the bacterized plant was compared to that of control one under stress condition. Proline accumulation and increase in chlorophyll concentration was higher in bacterized plant as compared to control. 16S rDNA-RFLP and BOX–PCR fingerprinting revealed huge genetic diversity among the isolates with different PGPR traits. ***Diversity and proteinase-producing bacteria isolated from rhino's dung*** Twenty four bacteria were isolated in four different media. Based on the sequence similarity of 16S rDNA and phylogenetic analysis, isolates belonged to nine genera, *Providencia* sp. (9 nos.), *Bacillus* sp. (5 nos.), *Pseudomonas* sp. (3 nos.), *Achromobacter* sp. (2 no.), *Brevibacillus* sp. (1 no.), *Sphingobacterium* sp. (1 no.), *Proteus* sp. (1 no.), *Caryophanon* sp. (1 no.) and Acinetobacter sp. (1 no.). The study revealed high degree of genetic variability among different genera of bacteria and Providencia is the predominant bacteria in rhino dung in this area. Only two strains *Achromobacter* sp. KRD9 and Providencia sp. KRD23 were found potential for proteinase production with molecular mass of 41kDa. The broad range temperature, pH dependency, dehairing ability, detergent stability and compatibility with consistent activity and excellent storage stability make the enzyme potentially useful for application in the detergent and leather industry. To our knowledge, this is the first report on genetic diversity and isolation of proteinase producing bacteria from rhino dung.
GAP	**Survey, isolation and preliminary characterization of microbial (bacteria) populations of Southern Brahmaputra corridor of Assam**
PI- Dr BG Unni CoPI- Dr SB Wann Funded by: DST, New Delhi	**Objective** (a) Survey of microbes (bacteria) from in and around the southern bank of Brahmaputra. (b) Isolation, identification and characterization of microbes (bacteria) from soil and analysis of soil samples from different locations having different environmental and soil conditions that provides nutrients to microbial populations **Salient Features** ***Isolation and Evaluation of PGPR effect on crops*** Bacterial strain was isolated and identified as Plant Growth Promoting Rhizobacteria (PGPR) which shows growth promotion on different vegetable crop plants. The Nutrient agar and Nutrient broth were used for culturing PGPR strains. A Pure culture of rhizobacterial strain was

	maintained in NA slants. The bacterial culture was spread by spraying near the root region of the individual plants and a 20% dilution of bacterial bioformulation was sprayed on leaves, stems and near the collar region of the crop plants. Similarly, a bacterial consortium (RB1+RB4+RB5) bioformulation was prepared and spread in the crop plants. The strains were identified at IMTECH, Chandigarh as follows: RB1 (MTCC 8297) *Bacillus cereus*, RB4 (MTCC 8299) & RB5 (MTCC 8300) *Pseudomonas rhodesiae*. The effect of PGPR on growth enhancement in crops, viz, chilli (*Capsicum annum*), brinjal (*Solanum melongena*), tomato (*S. lycopersicum*), cauliflower (*Brassica oleracea* var. botrytis), ladies finger (*Abelmoschus esculentus*), and rice (*Oryza sativa*) and tea (*Camellia sinensis*) was carried out in experimental field. The treated crops have shown various morphological differences like enhanced height, change in leaf colour, numbers of leaves etc. and have shown significant results in increase biomass when compared to control group. Two sets of crops have been planted, one treated with bioformulation and another without any treatment. The measurements and number of leaves were taken at regular intervals. Treated crops have shown a wide range of differences like number of leaves, height, early flowering compared to the control crops. The effects of the PGPR combinations in plants were also determined through estimation of biochemical parameters. Fruit samples of vegetable crops were collected after treatment with PGPR and were subjected for biochemical estimation. Estimation of Total carbohydrate content, total soluble protein and free amino acids analysis showed higher value in treated crops than the control.
GAP	**Development of formulations of microbial bioinoculants with plant growth promoting and biocontrol activities for application in rice cultivation in Manipur and Assam**
PI- Dr HP Deka Boruah Co Investigator- Dr M Khongsai Funded by: DBT, New Delhi	**Salient Achievements** Different *Pseudomonas* strains available with us were screened for in vitro antibiosis against the fungal pathogen *Pyriculari oryzae; Curvularia oryzae* and *Fusarium oxysporum* and to promote rice production under control condition. Three *Pseudomonas* strain TP16, TP15 and TP13 were found best against the above control three fungal strain and to promote plant growth. Detail field study is in progress to evaluate the strain for process development.
GAP	**Application of carbon sequestration in terrestrial ecosystem of Assam**
PI- Dr HP Deka Boruah Funded by: DST, New Delhi	**Objective** 1. Implications of Carbon sequestration in anthropogenically degraded land 1.1 Baseline data generation of carbon pool in ecologically degraded /restored land. 1.2 Contribution of plant species to C budget in such soil. 1.3 Assessment of plant ecotype study for optimization of carbon sequestration in ecologically degraded soil. 2. Assessment of C sequestration in forest ecosystems 2.1 Establishment of relationship of atmospheric CO_2, understory plant cover plant C and soil C in riparian forest areas. 2.2 Documentation of plant species for carbon sequestration ability in forest ecosystems. 2.3 Studies of forest species for CO_2 partitioning and C sequestration efficacy at functional eco- physiological levels.

Salient Achievements

Soil characteristic with respect to soil carbon and soil quality of the three reserve forest Jiadhal, Damra and Gibbon and species composition were compared. The average organic carbon for Jiadhol forest was 1.34%, 1.27% and 1.03% for respective depth with dehydrogenase activity 32.84µg $g^{-1}h^{-1}$, 4.27µg $g^{-1}h^{-1}$ and 1.8µg $g^{-1}h^{-1}$ and the moisture content were 10.76%, 3.23% and 3.22% respectively. For Damra forest it was 1.49%, 0.89% and 0.81% with dehydrogenase activity of 30.38µg $g^{-1}h^{-1}$, 6.17µg $g^{-1}h^{-1}$and 3.65µg $g^{-1}h^{-1}$ and the average moisture content were 24.65%, 23.57% and 22.55%. In Gibbon Wildlife Sanctuary, the average organic carbon found to be 1.59 %, 0.84% and 0.43% while dehydrogenase activities were 57.80µg $g^{-1}h^{-1}$, 16.78µg $g^{-1}h^{-1}$ and 8.57µg $g^{-1}h^{-1}$ and moisture content were 23.63 %, 20.05% and 18.42%. A total of 82 different plant species were found in all the three forest including 17 different plant species in Jiadhol , 28 different species in Damra and 55 different species in Gibbon. Among the plant species, 6 species were common to all the sites.

GAP

Genetic diversity of antimicrobial agents producing *Streptomyces* isolated from protected forest area of Assam and Arunachal Pradesh

PI-
Dr Ratul Saikia

CoPI-
Dr TC Bora
Dr MJ Bordoloi

Funded by:
DBT, New Delhi

Objective

- Genetic diversity of *Streptomyces* spp.
- Chemical profiling of antimicrobial metabolites.
- Selection of most efficient strain to control phytopathogen.

Salient Achievements

Screening of Streptomyces spp. for antimicrobial agent production

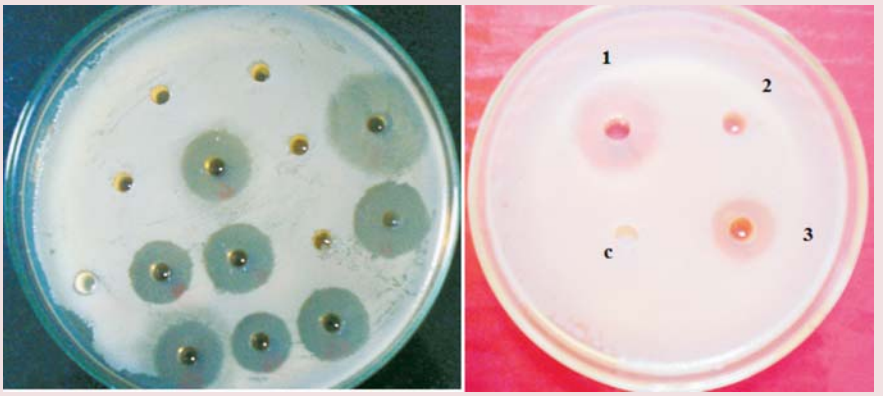
We have screened 200 nos. of Streptomyces strains for antimicrobial activity against fungal pathogens (*Candida albicans* MTCC3017, *Fusarium oxysporum* f. sp. ciceri NCIM1281, *Aspergillus niger, Rhizoctonia solani*) and bacterial pathogens, viz., *Staphylococcus aureus* MTCC96, *Bacillus subtilis* MTCC441, E. coli MTCC739) and *Pseudomonas aeruginosa* MTCC2458. Out of these strains, 8 nos. showed antifungal activity against *F. oxysporum, R. solani* and *C. albicans*. In case of bacteria, 16 nos. of strain showed antibacterial activity against *S. aureus* MTCC96 and *B. subtilis* MTCC441 (Fig. 2a) and six antifungal strains could degrade colloidal chitin in amended media. Antimicrobial metabolite was extracted from active strains 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 from the metabolite of *Streptomyces roseochromogenus* TSR12 and tested against the pathogens. Two fractions exhibited antibacterial activity against the bacteria (Fig. 2b). Further purification and chemical profiling of the bioactive compound(s) is in progress.

Phylogenetic analysis of antimicrobial Streptomyces strains isolated from Tawang

Fifty nos. of *Streptomyces* spp. isolated from Tawang were investigated for antifungal activity against *F. oxysporum* and 6 isolates were found to be positive. Sequencing of 16S rDNA of these *Streptomyces* was done and sequences to be submitted to NCBI-Gene Bank. Some isolates found to positive in proteinase and amylase production. Antifungal activity *Streptomyces* strains growing in colloidal chitin amended media were subsequently amplified gene coding for Family 18 chitinase A (ChiA). A real

time qPCR comparative $\Delta\Delta C_T$ study among the six isolates showed glycosyl hydrolase (GTR25) to be the transcriptionally active.

The six antimicrobial agent producing strains were identified as *Streptomyces virginiae, S. sporoverrucosus, S. roseochromogenus, S. kanamycelicus, S. purpeofuscus* and *S. indigoferus* which were exhibited great genetic diversity (Fig. 3).



a b

Fig. 2. a. Screening of bioactive metabolite of Streptomyces sp. against Candida albicans; b. Bioassay results of TLC purified compound (fraction 1, 2 and 3; c - control); extracted from S. roseochromogenus

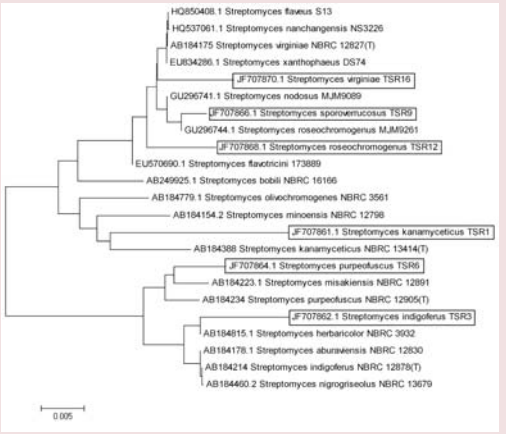


Fig. 3. Maximum-parsimonious phylogenetic consensus tree, derived from 16S rDNA partial sequence data, showing the affiliation of the Streptomyces isolates

Chemical Sciences

GAP	Synthesis of biologically potential azasteroids via steroidal B-ring modifications
PI- Dr R C Boruah CoPI- Dr D Prajapati Funded by: DST, New Delhi	**Objective** Synthesis of B-ring annelated steroidal heterocyclic compounds using chemistry of ß̃formyl enamides. Development of new methodologies for the synthesis of steroidal macrocycles. Synthesis of triazolosteroids involving click chemistry at B-ring. Biological screening of the novel azasteroids **Salient Features** Tetrazoles are important nitrogen rich ring system which exhibit interesting biological properties. The fused tetrazolo[1,5-a]pyridine systems have been used as azide surrogate in click reaction for efficient synthesis of 1,2,3-triazoles. Tetrazolo[1,5-a]pyridines are also precursors of pyridylnitrenes under thermal/photochemical condition and are convenient sources of

pyrazoles, pyrroles, iminophosphoranes and 1,3-diazepines/diazepinones. Tetrazolopyridines are typically prepared by heating 2-halopyridine with NaN_3/$TMSN_3$ in the presence of TBAF or by treatment of pyridine N-oxides with sulfonyl or phosphoryl azides and pyridines in the presence of solvent. A facile synthesis of a novel class of steroidal A/B/D-ring annulated tetrazolo[1,5-a]pyridine derivatives has been accomplished via intramolecular 1,3-dipolar cycloaddition reaction of azide with nitrile in aprotic solvent. The synthesis of D-ring annulated tetrazolo[1,5-a]pyridine in alcohol showed incorporation of an alcohol molecule into heterocyclic system.

GAP

Domino Diels-Alder & dipolar cycloaddition reactions in the synthesis of carbazoles & carbolines: Synthesis of some new analogues of carbazole and carboline alkaloids and assay for their potential biological activity

PI-
Dr Pulakjyoti Bhuyan

CoPI-
Dr TC Bora

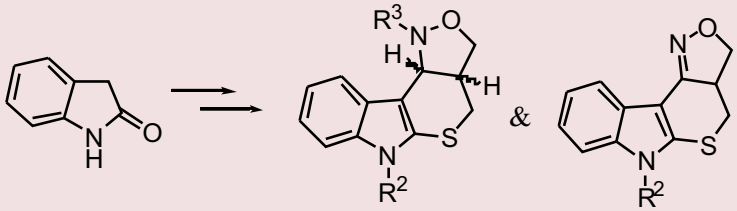
Funded by:
DST, New Delhi

Objective

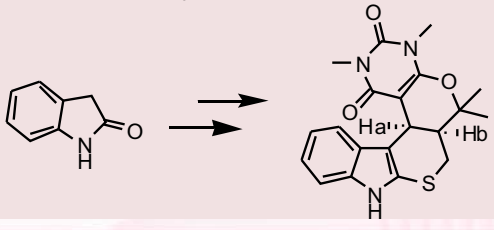
The objective of the project is to synthesise some novel analogues of biologically active carbazole and carboline alkaloids and assay for their potential biological activities. Attention is to be given in the adaptation of sustainable chemistry e.g. cycloaddition reaction, solvent-free reaction, multicomponent reaction etc in the synthesis of the new molecules of interest

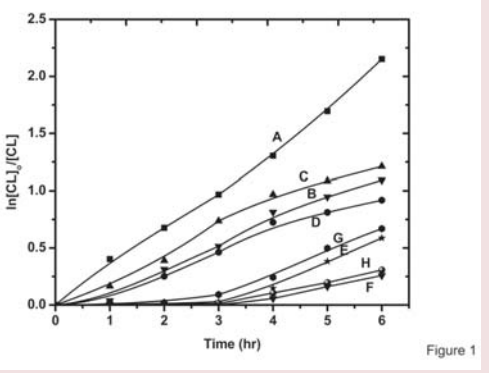
Salient Features

As per objective several novel tetrahydroisoxazolo-, dihydroisoxazolo fused thiopyrano[2,3-b]indoles were synthesised from simple oxindole via intramolecular 1,3-dipolar cycloaddition reactions involving nitrones and nitrile oxides as 1,3-dipoles, in a regioselective manner.



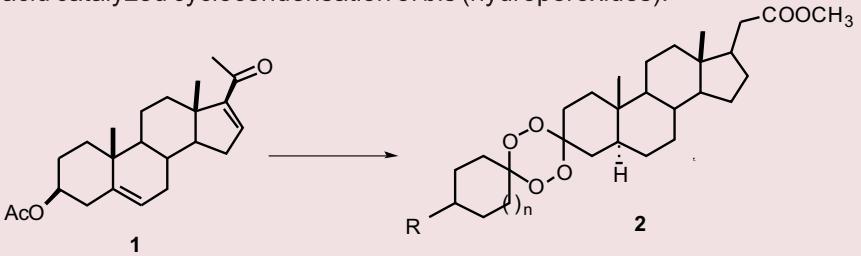
In another achievement a simple and efficient method was developed for the synthesis of some novel thiopyrano indole derivatives from simple oxindole via intramolecular domino hetero Diels–Alder involving oxabutadiene as dienophile. The reaction also demonstrated an efficient synthesis for Boc deprotection in basic conditions without disturbing aldehyde functionality besides having other advantages such as clean reactions, low loading of catalyst, high yields of products, and short reaction times for the synthesis of pentacyclic indole derivatives.



GAP	**Biodegradable polymeric composites based on cellulose nanoparticles: an alternative to petroleum-based polymer composites**
PI- Dr SD Baruah Funded by: DST, New Delhi.	**Objective** To study the kinetics of ROP of CL onto isolated CMFs. **Salient Features** The kinetics of ROP of CL onto isolated CMFs was studied at different reaction condition. The kinetic parameters for grafting were evaluated. The fraction of PCL in the CMF-PCL grafted products were calculated from thermal investigations. The crystallinity and melting behavior of the grafted copolymers were studied by DSC and a significant difference was observed on thermal behavior of the grafted products.  Figure 1 With metal triflates, the grafting of CL onto CMF proceeds with an induction period (Figure 1). The free PCL formed in the grafting reaction show the presence of a shoulder of high molecular weight (MW) polymer. In ROP, intra- and intermolecular trans-esterifications rather than disproportional rearrangements are responsible for the bimodal MWD and for the change in the MW. The PCL end group of CMF-g-PCL graft copolymer was converted into initiating sites for ATRP and the chain extension of the PCL block was done by grafting with poly(glycidyl methacrylate) (PGMA). The length of PGMA chains were varied through termination at different time intervals. The ATRP of GMA onto PCL-g-CMF follows first order kinetics with respect to GMA concentration. CMF-g-PCL and CMF-g-PCL-g-GMA exhibit a very similar rheological behaviour over the entire frequency range, showing a non-Newtonian shear-thinning rheology.
GAP	**Synthesis of some versatile steroidal molecules : approach to synthesis of hybrid molecules including nine membered D-ring steroids and chemeric 7α-substituted derivatives**
PI- Dr A M Das Funded by: DST, New Delhi	**Objective** The project work involves on 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. **Salient Features** The project work was focused on formation of bis (dioxy) moiety into steroid nuclei in order to alter the biological activity of the parent molecule which has been a productive endeavor for medicinal chemists with potent antimalarial

and antimycobactarial activity. Considering the remarkable application of novel tetroxane (bis-dioxy), we have designed and synthesized the unsymmetrical dispiro 1,2,4,5 tetroxane with reference to steroidal ketone possessing antimalarial and antimycobactarial activity using new & innovative synthetic schemes.

This work presented was to develop novel stable unsymmetrical steroidal based spirocycloalkane 1,2,4,5 tetraoxane 2 starting from 16-dehydropregnenolone acetate 1 or related 21-chloro-20-oxopregnane via acid catalyzed cyclocondensation of bis (hydroperoxides).



1 2

GAP

Synthesis of novel pyrimidine derivatives biological significance based on inter and intramolecular cycloaddition strategy

PI-
Dr Dipak Prajapati

CoPI-
Dr Romesh Ch Boruah

Funded by:
DST, New Delhi

Objective

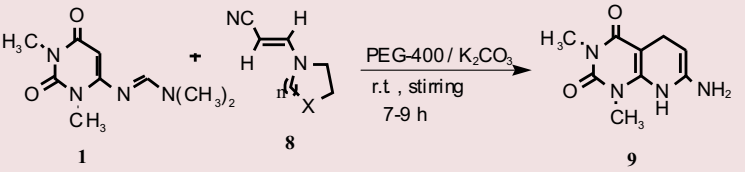
The main objective of the present proposal is to investigate the application of cycloaddition chemistry to the basic skeleton of pyrimidines to construct newer molecules of biological significance which will pave the way in devising a new methodology in the synthesis of complex natural products. Also to study

- 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 most finest nature i.e. stereospecificity, regiospecificity and asymetric synthesis.

Salient Features

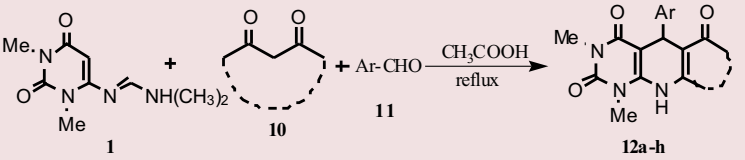
Synthesis of Pyrido[2,3-d]pyrimidine derivatives

When uracil amidine 1 was reacted with 2-amino-substituted acrylonitriles 8 in PEG-400 and in presence of 10 mol% of K_2CO_3 at room temperature, to our delight, 5,8-dihydropyrido[2,3-d]pyrimidine 9 formed directly without the formation of any intermediate (Scheme 4). We then generalized the reaction by taking different amine substituents in 8 and observed that cyclic secondary amines like morpholine, piperidine and pyrrolidine leads to generation of the same product after elimination of the amine moiety. However, when N,N-diphenyl amine was taken as the substituent, the reaction did not proceed at all despite long reaction time and the reactants were quantitatively recovered. This could be due to the large steric hindrance offered by the phenyl groups that renders the initial step sterically unfavorable.



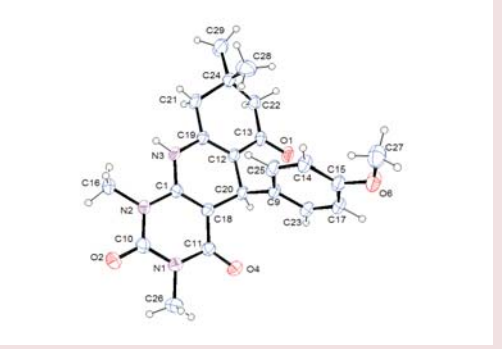
1 8 9

Then cyano group of 2-amino-substituted acrylonitriles was replaced with a carbonyl group and reacted with uracil amidine and got the corresponding pyrido[2,3-d]pyrimidine derivatives in high yields. It was established that like a cyano group, the carbonyl group also provides a potential site for the nucleophilic N atom of 1 to attack and thus should undergo the same reaction pathway. Initially 1,3-diketones was selected as potential active methylene candidates for this reaction.



1 10 11 12a-h

Subsequently, a three component reaction between uracil amidine 1, an aldehyde and acetyl acetone 10 was carried out in acetic acid and refluxed for appropriate time to get the products. The structure of the compound 12a was assigned from its spectral analysis and finally by X-ray crystallography.



12a

GAP	**Utilization of plant and waste materials of North-East India to a value added product : environment friendly technology**
PI- Dr A M Das Member Dr Dilip Knowar Dr NC Barua Dr TC Bora Funded by: NEC, Shillong	**Objective** The project work involves on extraction of cellulose from selected plants and waste plants and conversion of cellulose to value-added products such as biofuel, vanillin etc. using eco-friendly solvents and reagents. **Salient Features** The project work covers the work embodied for the extraction of lignocellulose from potential plant biomass and simultaneously, the production of economically important compounds vanillin and ferulic acid which have enormous biotechnological value and finely the conversion of holocellulose to ethanol. Some plants and agricultural wastes easily available in nearby Jorhat town were collected and cut into small pieces. After that the biomass was kept for drying in open air and powdered. The powdered materials were collected and extracted with both non-polar and polar solvents, to remove undesirable material such as waxes, fats, resins,

	phytosterols and non volatile hydrocarbons of the plant species. After solvent extraction using soxhlet apparatus, the biomass was used to separate out the content of lignin and hemicelluloses. Cellulose was extracted by using alkali hydrolysis method using suitable base and temperature. The black liquor obtained as a filtrate after the base hydrolysis step (generally termed as Kraft Black liquor) was again used for extraction of other value added products like vanillin and lignin. Cellulose is converted to Glucose using standard as well as green methods.
GAP	**Biotech intervention on selected medicinal and aromatic plants of NER for their effective utilization**
PI- Dr P R Bhattacharya CoPI- Dr S C Nath Dr M Barthakur Dr B S Bhau Dr Gakul Baishya *Collaborator* Dr Chandana Choudhury Barua Dr Iswar Chandra Barua Dr M Ahmed Funded by: DBT, New Delhi	**Objective** ● To work out the taxonomy of the germplasm of the four medicinal and aromatic plants. ● To investigate bioactive phytochemical ingredients of selected species for an effective utilization of these unique resources. ● To evaluate pharmacological activity of the plant extracts and their various fractions. ● To assess the drug isolated for potential adverse eefects on metabolic system. ● To develop technology of good agricultural practices, mass multiplication and post-harvest management **Salient Features** Two extracts of the plant *Clerodendrum indicum*, one with ethanol and the other with 50% aqueous ethanol of have been prepared and submitted to College of Veterinary science, Assam Agricultural University for in vivo anti ulcer and anti arthritic studies. Results were awaited.
GAP	**Domino prins cyclization reactions: syntheses of novel highly functionalized tetrahydropyran and piperidine derivatives**
PI- Dr Gakul Baishya Funded by: DST, New Delhi	**Objective** ● To develop new domino Prins cyclization reactions as novel synthetic methods. ● To target some natural products of biological importance using aza-Prins cyclization reaction. **Salient Features** A solid acid catalyst was prepared from Montmorillonite K10 clay and applied to Prins cyclization reaction of (-)-isopulegol with different aldehydes. The catalyst has been found to be very effective.
Inhouse	**Extraction, isolation, phytochemical analysis, partial & total synthesis of biologically active natural products for value addition**
PI- Dr NC Barua Members- Dr PK Chowdhury Dr MJ Bordoloi Dr DK Dutta Dr AM Das Dr G Baisya, Ms P Borah Mrs Rumi Borah Mr B Borah Mr R Saikia	**Objective** ● Plant parts of selected medicinal plants of North East India would be extracted and extracts would be sent for bio-evaluation against different diseases and pests. ● Chemical investigation of selected medicinal plants would be taken-up in search for novel molecules for probable use as drug/pest control agents. ● Phytochemical analysis of plant materials would be taken up as service to farmers/entrepreneurs of North East India as and when such samples are received.

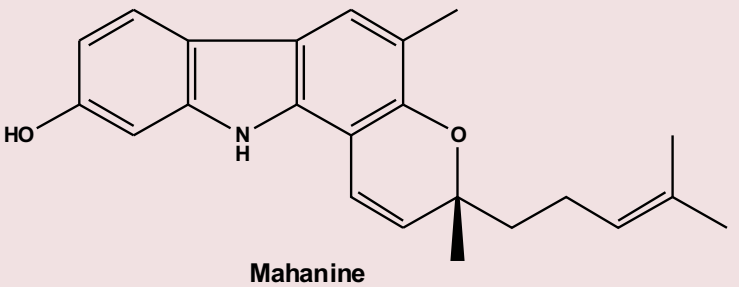
Funded by:
CSIR, New Delhi

- Novel derivatives of artemisinin and steroid would be made for value addition
- Total synthesis of selected less abundant natural products would be taken-up to make it available and also to solve structural problem.
- Two New Steroid derivatives would be synthesized.

Salient Features

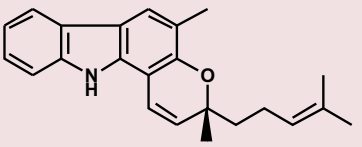
During this period several medicinal plants were chemically investigated in search of novel molecules. This work yielded several new molecules which were characterized and subsequently published. In addition to this work was carried out in collaboration with Visva Bharati, Santiniketan on a plant *Cajanus cajan* and isolated a flavon glycoside. The juice of the tender leaves of *C. cajan* is traditionally used to treat jaundice in the Brahmaputra valley. Phytochemical analysis service to several farmers from Nagaland for Turmeric samples were provided.

In collaboration with Georgetown University, USA, CSIR-NEIST initiatied academic collaboration on development of Mahanine, a carbazole alkaloid found in Indian curry patta, *Murraya koienigii*, as a probable drug candidate for treatment of prostate cancer. Preliminary studies at CSIR-NEIST/Georgetown University established the strong in vitro activity of mahanine against prostate cancer. Plan using in vivo studies on diseases animal models and identification of the target(s) initiated.

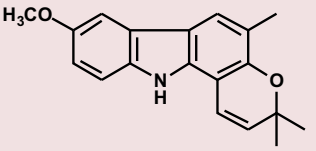


Mahanine

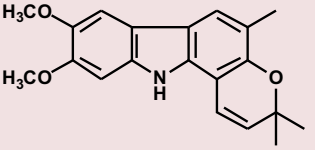
It Was observed that the *Murraya koienigii* collected at Jorhat gave three other alkaloids namely Isomahanimbin, Koinimbin and Koinidine and very little of mahanine. Whereas the plant collected from Santiniketan area contains mahanine as the major constituent with other three compounds viz. Isomahanimbin, Koinimbin and Koinidine only as minor constituents. Therefore the material from Santiniketan was selected for the work.



Isomahanimbine

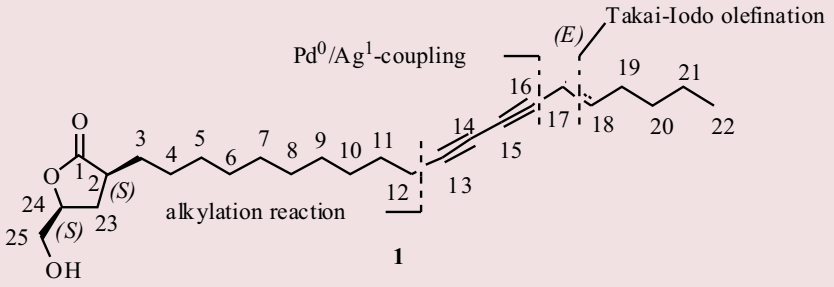


Koenimbine

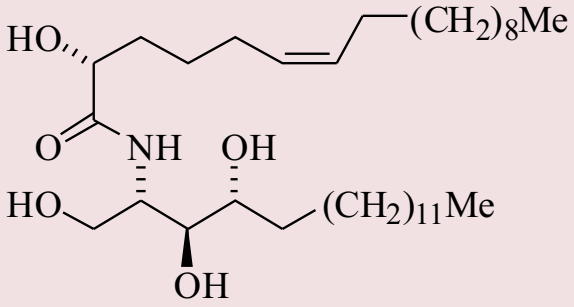


Koenidine

The following two very important biologically active molecules was synthesized for the first time.



Debilisone C (A Anti TB compound)



A biologically active sphingolipid with promising anti cancer activity

Inhouse

Development of new analogues of Drugs & intermediates

PI-
Dr RC Boruah

Members-
Dr D Prajapati
Dr PJ Bhuyan
Dr HN Borah
Mr KC Lekhok

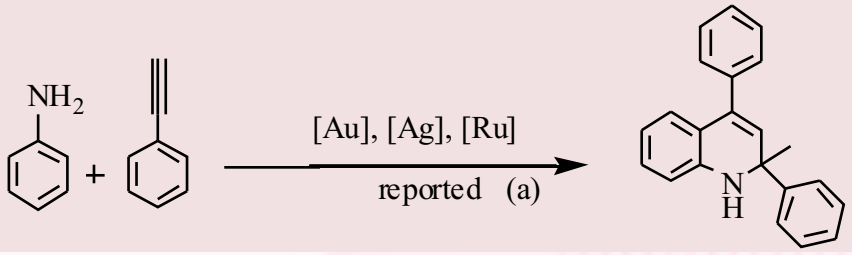
Funded by:
CSIR, New Delhi

Objective

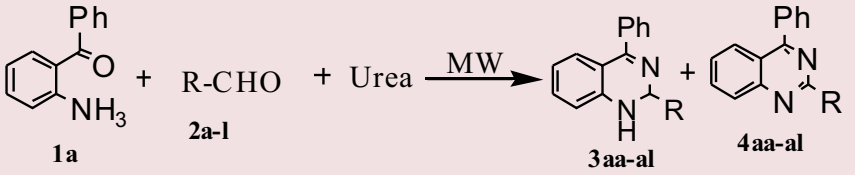
I) Development of analogues of antibacterial, antiviral and anti-hypertensive agents
ii) Development of newer organic and biotransformation reactions
iii)Development of analogues of newer steroidal antitumour agents

Salient Features

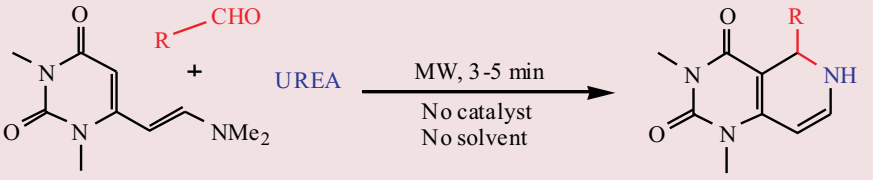
Indium catalyzed tandem hydroamination/hydroalkylation of terminal alkynes: The first direct intermolecular hydroamination/ hydroalkylation of terminal alkynes catalyzed by $In(OTf)_3$ under one-pot conditions leading to the formation of conjugated ketimines in good yields and in absence of any other additive and/or co-catalyst was investigated. A range of arylamines and alkynes were studied and good yields of the products were obtained. This methodology offers a new approach for the synthesis of conjugated ketimines from simple starting materials with excellent atom-economy.



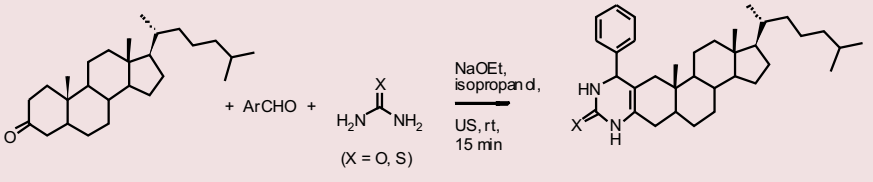
Microwave promoted efficient and green synthesis of dihydroquinazolines: A range of substituted 2-aminobenzophenones and aldehydes were shown to undergo a microwave promoted three component, one pot reaction with urea to generate a library of 2,4-disubstituted-1,2-dihydroquinazolines and 2,4-disubstituted quinazolines under catalyst and solvent free conditions. This methodology worked equally well when ammonium acetate is employed as the source of ammonia in place of urea. This approach offered an environmentally friendly and 'green' alternative towards removing organic solvents from organic synthesis.



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 was developed. A range of aromatic, heteroaromatic and conjugated aldehydes were shown to participate in the reaction when carried out inside a microwave reactor in absence of any solvent or catalyst. The reaction could be suitably tuned simply by varying the reaction time to obtain aromatic pyrido[4,3-d]pyrimidines. It was further demonstrated that this methodology could 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 was simple, efficient and provides an alternative towards removing organic solvents from organic synthesis.



The ultrasound-assisted three component reaction of steroidal/non-steroidal ketones, alkyl/arylaldehydes and urea/thiourea in presence of sodium ethoxide afforded 3,4-dihydropyrimidin-2(1H)-one/thione fused steroidal derivatives in good yields umder mild conditions in short reaction times.

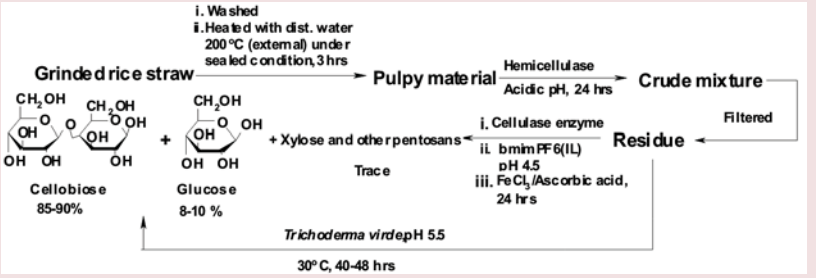


Inhouse	Biodegradable polymer based nanocomposites
PI- Dr SD Baruah Member- Dr A Borthakur Mr A Gautam Mr NC Laskar Mr A Sarmah Mr RC Bohra MT L Phukan Funded by: CSIR, New Delhi	**Objective** **Salient Features** Natural cellulose from different sources was used as a macroinitiator for the ring opening polymerization (ROP) of ε-caprolactone (CL) for the synthesis of polymer with a cellulose backbone grafted with poly(ε-caprolactone) (PCL). The PCL end groups of the graft copolymer then converted into initiating sites for graft atom transfer radical polymerization (ATRP) of glycidyl methacryalte (GMA) to obtain a hydrophobic graft-on-graft architecture. Due to biodegradability and favourable mechanical property, cellulose microfibrils (CMFs) are widely used in medical, food, packaging and cosmetic industrial applications. CMFs isolated from different cellulosic sources also thoroughly studied as macroinitiator for synthesis of high molecular weight comb block copolymers consisting of CMF backbone, inner blocks of PCL and polylactide (PL) and outer blocks of different lengths of n-alkyl methacrylates/epoxy methacrylates using a combination of ROP and ATRP. The length of methacrylates/epoxy chains was controlled to establish the degradation behavior of grafted products. Chitosan based biodegradable polymers were also developed by grafting of ε-caprolactone and GMA onto phthaloylchitosan by combination of ROP and ATRP reactions. The cellulose substrate and grafted products were characterized by SEM analysis. The crystallinity and melting behavior of the grafted copolymers were also studied by DSC and TMA analysis and thermal degradation mechanism was established. Significant difference was observed on thermal and thermomechanical behavior of the grafted products. The degradation behaviour of PCL/PLA containing cellulose composites was monitored by various standard ASTM methods. Potato starch was modified by esterification with propionic anhydride using DMAP and sodium bicarbonate as catalyst in dimethyl sulfoxide. FTIR studies established the presence of ester group. TGA studies confirm that the thermal stability of starch acetate increases with the increase of degree of substitution of acetate group. The XRD pattern of starch acetate indicates that it is amorphous in nature exhibiting only a broad peak without any clear cut crystalline peak.
Inhouse	**Industrially important organic molecules from renewable resources**
Coordinator- Dr JCS Kataky PI- Dr D Konwar Dr A Goswami Member- Dr Pallav Pahari Mr RN Das Mr MJ Borah Funded by: CSIR, New Delhi	**Objective** ● Creation of value-added products from renewable resources such as agro wastes of rice straw, rice husk etc. ● Development of a Green chemistry method for conversion of lignin/ferulic acid of such resources to vanillin and other valuable aromatic compounds ● Use of hydrogen peroxide/air as green oxidizing agent and water a green solvent in the reaction media ● Extension of the study to some other Graminaceous plants such as bamboo ● Separation of lignin from cellulose after obtaining the industrially important aromatic compounds from the agro-waste preparation of value-added products

- Development of Green chemistry methods for preparation of esters as bio-diesel components from oils of plant origin. Development of technology

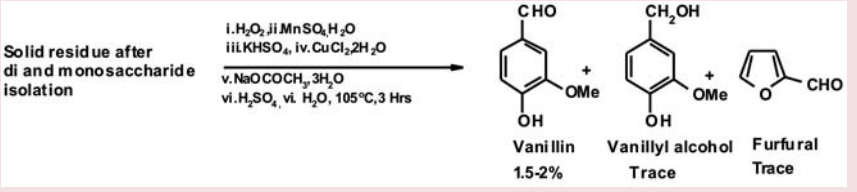
Salient Features

Grinded rice straw was first washed with distilled water and heated under sealed condition at more than 200ºC (external) temperature for several hours to make it pulpy loosening the binding of lignin with cellulose. After that it was cooled filtered and the residue was treated with hemicellulase at acidic pH for 24 hours under shaking at room temperature (25ºC) in order to breakdown the gummy hemicellulose. After that the reaction mixture was filtered. The residue after dividing into two parts and treatment of one part with cellulase enzyme at pH 4.5 in ionic liquid bmim PF_6 in presence of $FeCl_3$ and ascorbic acid gave cellobiose 85-90% and glucose 8-10 % in the filtrate (HPLC). The second part also on treatment with Trichoderma fungal strain cultured from a local formulation product Bioderma at room temperature at acidic pH (5.5) under shaking in a buffer for more than 40-48 hours and after filtration also showed cellobiose formation 67-70% with approximately 9% glucose (HPLC) along with trace amount of xylose, and other unidentified materials (Scheme-1).



Scheme 1

The solid residue left after isolation of disaccharide (cellobiose) and monosaccharide (glucose, xylose etc) through enzymatic /microbial reactions, on oxidation with hydrogen peroxide in presence of Mn(II) salt in presence of co-catalyst $CuCl_2$ and $KHSO_4$ under acidic condition at above 100°C in 3 hours could give approximately 2% vanillin,0.2% vanillyl alcohol and trace amount of furfural (Scheme-2).

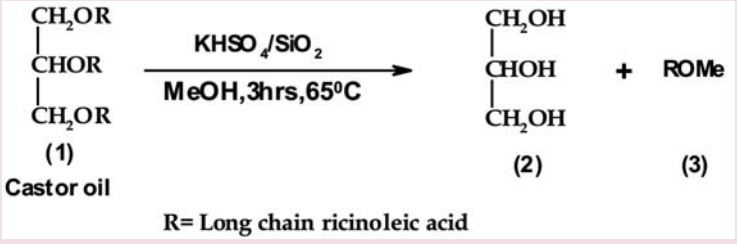


Scheme 2

(iii) Transition metal nano particles on cellulose template. Work on preparation transition metal nano particles [Ni, Cu] on cellulose template has been initiated following standard protocol and the materials formed have been under investigation through SEM/TEM analysis.

(iv) Lab scale work on castor oil biodiesel. Potassium bisulphate supported on mesoporous silica has been used successfully as very effective catalyst in castor oil transesterification with methanol to prepare biodiesel from

castor oil (CastMe,3, Scheme-3). The textural properties of the catalyst system such as pore diameter, surface area, pore volume etc were determined using Quantachrome Automated Gas Sorption system were optimized.



Scheme 3

The physical properties of CastMe (3,Scheme-3)) viz. kinematic viscosity, density, pour point, and cloud point have been determined following standard ASTM D675 method. The properties of CastMe are comparable to those of petrodiesel and acceptable within what is specified for 100 % pure biodiesel as per ASTM standard except that of viscosity and cetane numbers which are the bottlenecks. However, 10% or 20% blended CastMe with petrodiesel that are known as B10 and B20 have their kinetic viscosity 4.54 & 4.97 mm2/s and are within ASTM standard. The reaction was standardized and the catalyst has been reused for 7 runs. The process is ready for demonstration.

Inhouse

North East exploration of pharmaceuticals (NEEP)

Coordinator-
Dr PG Rao

Mission Director-
Prof Samir Bhattacharya
(Visva Bharati, Santiniketan)

Project Director-
Dr MJ Bordoloi

Members
Dr NC Barua
Dr MBhuyan
Dr PR Bhattacharya
Dr SC Nath
Dr G Baisya

Funded by:
CSIR, New Delhi

Objective

- Preliminary objective of this project is to develop affordable medicines from the rich resources of medicinal plants of North East.
- A database on traditional herbal products used by different tribes/ethnic population in the North East India
- To create a list of medicinal plants with their medicinal use and awareness among young students about this resources
- To culminate the activities of each disease directed group, chemical compound and /or fraction with convincing activity will be tested for toxicity and then subjected to therapeutic trials starting from animal disease model to human being. It will be arranged to secure IPR for each material and finally organized for transfer of this technology to suitable pharma company

Salient Features

- Carlinoside, a flavone glycoside, isolated from the leaf of a plant and found to remove insoluble bilirubin by solubilizing the same through UGT1A1 expression by Nrf2. Besides in vitro cell line work (HepG2), in in vivo hyperbilirubinemic rat model also Carlinoside showed promise for jaundice treatment where accumulation of bilirubin induced toxicity of liver is a major problem.
- An antifungal herbal formulation was developed from principles of plants. Clinical trial has been done on ~1000 patients.
- An anti arthritis herbal formulation was developed from principles of plants. Ongoing clinical trials showed effectiveness in human beings.

- Two molecules volatile in nature were purified from an endemic plant of North-East (code no. nstvb 021 and nstvb 022) showed anti-lung cancer activity by inducing the expression of epigenetically silenced tumor suppressor gene. One of the greatest advantages of these two molecules is their volatileness which would permit direct delivery to the lungs affected with cancer.
- An isoflavone (vbnst 902) derived from plant source down regulates Bcl-xL and Cyclin D1 in breast cancer cells which suppress their proliferation and affects survivability. Interestingly, it acts at a nanomolar concentration on MDA-MB-231 breast cancer cells.
- A database on traditional herbal products used by different tribes/ethnic population in the North East India has been prepared. One thousand recipes were included comprising 500 plant species.
- An investigatory project competition was organized among the young talents from schools and colleges of NE India and created awareness and motivation among young students about medicinal plants with their medicinal use, etc.

The anti arthritis cream

The anti fungal cream

Engineering Sciences

GAP	**Tripura footwear training cum production centre location: Udaipur, South Tripura district**
Chief Advisor- Dr P G Rao PI- Mr Dipankar Neog Members- Mr SC Kalita, Mr JJ Bora Funded by: CSIR-CLRI under HRD Mission	**Objective:** ➢ To generate trained man-power suitable for footwear industry. ➢ To generate entrepreneurship. ➢ To cater to the demand for non leather footwear in the region, primarily for children's footwear. ➢ To run the center on self sustainability basis. **Salient Features** ➢ 18 numbers of footwear manufacturing machineries installed in the center. ➢ The centre runs in a self sustainable profit making business model.

	➢ The centre consists of four departments: Design and Pattern Making, Cutting and Clicking, Pre Closing and Closing, Lasting and Finishing. ➢ 20 trainees in four different batches has successfully completed training programme. ➢ The centre opened its own retail outlet shop at commercial centre of the Udaipur city.
GAP	**Tripura footwear training cum production centre location: Tezpur, Sonitpur Assam**
Chief Advisor- Dr PG Rao PI- Mr Dipankar Neog Members- Mr SC Kalita Mr JJ Bora Funded by: CSIR-CLRI under HRD Mission	**Objective** ➢ 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 Features** ➢ 17 numbers of footwear manufacturing machineries installed in the center. ➢ The first batch of training is going on. (No of Trainees: 08) ➢ The centre runs in a self sustainable profit making business model. (Production about to start) ➢ The centre consists of four departments: Design and Pattern Making, Cutting and Clicking, Pre Closing and Closing, Lasting and Finishing.
GAP	**Technopreneur promotion progrmme (Tepp) outreachcCenter of NEIST Jorhat (TUC-NEIST)**
Chief Advisor- Dr PG Rao PI and TUC Coordinator- Mr Dipankar Neog Advisor- Mr P Barkakoti Members- Mr JJ Bora Ms I Ilika Zhimo Dr (Ms) Dipanwita Banik Mr Ajoy Borkatoki Funded by: DSIR, New Delhi	**Objective** ➢ To promote and support untapped creativity of individual 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. **Salient Features** ➢ 7 numbers of projects total amounting to Rs. 20,99,000.00 (Rupees Twenty Lakhs Ninety Nine Thousand) is sanctioned by DSIR under TUC-NEIST out of which five projects have been completed. ➢ 5 numbers of projects are in the pipeline of sending to DSIR, New Delhi. ➢ TUC-NEIST conducts workshops, innovation competitions among the students. ➢ Provides technical guidance to the individual innovators of Indian citizenship.
GAP	**Development of landslide monitoring system for North-East Regions of India using wireless sensor networks**
PI- Dr PC.Sarmah Member- Mr K Buragohain Dr R Duwarah Dr P Kotoky	**Objective** i) Development of Landslide Monitoring system using Wireless Sensor Networking. ii) Prediction of Landslide; and iii) Providing early warning to the concerned authorities and surrounding people.

Mr Probin Sarmah Mr Amar J Gogoi Mr Kh Deepen Singh Funded by: DIT, New Delhi	**Salient Features** Laboratory prototype of the technology on RFID communication from 5 geophysical sensors were already explored. The communication of the signals to Server and thereafter to remote places were also tested. Field trial of the prototype developed was under progress at a landslide prone area Karsingsa, Arunachal Pradesh. The installation of five geophysical sensors at the place of landslide, at hill top was done and communication to the sensor through wireless system was tested. The monitoring of data was in progress.
GAP	**Development of nanostructured membrane for solvent recovery from dilute solution**
PI- Dr Swapnali Hazarika Member- Mr S Borthakur Dr M M Bora Funded by: DST, New Delhi	**Objective** To develop nanostructured membrane for solvent recovery from simulated effluent mixture of 2-3% concentration using various membranes prepared from novel polymers such as cyclodextrin, dendrimer etc. and compare their performance with model NF membranes available commercially. Also, to make a QSAR study for membrane permeabilities vs solute/solvent properties and optimize the operating conditions in a flat sheet membrane cell. **Salient Features** Nanofiltration membranes (NF) was prepared from novel polymers such as Alpha Beta and Gamma cyclodextrin, Dendrimer etc. and characterized by IR, NMR, GPC, TGA, DSC, XRD, pore size, porosity, SEM and TEM analysis. Effect of casting solvent on membrane morphology was also studied using four different casting solvents such as N-methyl pyrrolidone (NMP), Dimethyl sulfoxide (DMSO), Dimethyl acetamide (DMAc) and Dimethyl formamide (DMF) and interpreted by considering Hansen solubility parameter. A comparative study was also made between indigenously developed membranes and commercial NF membrane. Microvoid formation during membrane casting was investigated by an instrument available in our institute. However data obtained from this instrument were not sufficient to establish the detail mechanism. Permeation experiment for recovery of Acetic acid, Methanol, Ethanol, Butanol from aqueous solution (<3%) was done using indigenously developed NF membranes and compared with commercially available NF membrane. The performance of our indigenously developed NF membranes was 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 was 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	**Development of environmentally benign process technology for extraction of natural dye of NE Region**
PI- Dr MM Bora CoPI- Mr S Borthakur Member- Dr S Hazarika	**Objective** To develop appropriate adsorption and membrane module for extraction of natural dye component and a total technology package with techno-economic feasibility. The ultimate objective will be to evolve a strategy that would lead to development of marketable know-how through involvement of the end user once the technology is fully developed.