

From Director's Desk.....



It gives me immense pleasure to present the Annual Report of the laboratory for the year 2005-2006. The report will provide a glimpse of the various activities performed by the laboratory in terms of research and development, network projects, processes released, papers published, patent filed, human resources development, societal benefits, seminar-symposia-meeting organised, honours, recognition and awards received, etc. It is indeed a great pleasure for me to put on record that performance-wise it had been just another successful year for the laboratory. As had been the case earlier, the dedicated band of RRL staff made the best endeavours to keep up the various national commitments and priorities as demanded by the country's new economic order. I am proud to announce that the laboratory could progress well and achieved the desired national objectives as were expected of us with fair degree of successes. The laboratory, during the year, engaged itself intensely in the applied as well as basic research and also in the extension activities under its rural

development programme. The spectrum of laboratory's R&D mainly focussed on five broad areas namely Biotechnology, Chemical Sciences, Engineering Sciences, Environmental Sciences and Earth Sciences and the achievements made are placed on record in terms of Science Outputs, HRD and External Cash Flow generated, etc.

Among the significant achievements the laboratory made during the year, the first and foremost being the conferring of ISO 9001-2000 quality certificate to the laboratory by the international quality audit. 'DET NORSKE VERITAS (DNV)' of Netherlands. The DNV found the Quality Management System of RRL-Jorhat to conform to the quality management standard and hence conferred the Management System Certificate to it which was formally handed over to the laboratory on 63rd Foundation Day celebration of CSIR at RRL. Mention can be made about the transfer of the Low Dust Chalk Pencil process to two more parties within the state and three parties reportedly commenced production. Of the new projects contracted by the laboratory during the year, 11 were Grants-in-Aid, 1 collaborative assignments and 7 were consultancies with a total contract value of Rs. 318.9 lakh. The laboratory rendered testing/analysis/technical services to more than 200 of its regular and other clients comprising of R&D establishments, industries, manufacturers, tea-gardens, govt. departments and others private agencies earning an amount of Rs. 8.1 lakh. On the publication side, the laboratory published a total of 65 research papers in various reputed national and international journals with an average Impact Factor of 1.866. I feel satisfied to announce that this year the quality of our research papers had improved a lot over the previous year in terms of impact factor.

On the societal front, a total of 176 hectares of land were newly brought under the cultivation of aromatic plants in places like Mizoram, Arunachal Pradesh and installation of 5 distillation units in those areas thereby creating employment avenues for 760 numbers of rural people.

During the period a total of 15 projects including 6 consultancies were completed and the final reports were submitted to the respective parties. The laboratory earned an amount of Rs.327 lakh as External Cash Flow through various contract research, consultancy, testing/analyses, etc.

The year had been particularly busy in terms of organising important seminars, workshops, interactive meets, etc. The holding of national seminars such as Awareness of Recent Advances in Science & Technology, Crop Disease Management for Improving Productivity, National Awareness Programme on Application of Radiation Technology for societal benefits, Natural Hazards Awareness Programme held at Nagaland, Awareness Programme on RRL Technologies for Microentrepreneurs, Technology Demonstration Workshop held at Sikkim, Workshop on Popularising Organic Farming in Arunachal Pradesh, Interactive Meet on RRL Technologies, Workshop-cum-Interactive Meet on Utilization of North East Coals, etc. were not only of very special significance and value, but also very much rewarding to the local entrepreneurs and researchers. During the year, the laboratory entered into 3 important Memorandum of Understanding with the reputed centres of learning viz. Allahabad Agricultural Institute - a deemed university, Assam Medical College, Dibrugarh (Assam) and POGL Institute for Petroleum and Energy Development, Guwahati for functional coordination and human resource development in Science & Technology.

Under the HRD programme of the laboratory, 12 staff members were awarded the degree of Doctor of Philosophy in different disciplines of science by the various Indian universities.

I feel quite elated to announce that the reporting year had been one of the most fulfilling years in so far as the achievements of the laboratory are concerned having bagged as many as 5 national awards and 1 post-doctoral research international fellowship which are namely Fellow of National Academy of Science (FNASc), India, Allahabad awarded to Dr R C Boruah, Scientist F for his significant contribution in the field of Chemical Sciences, Dr Biraj Mohan Das Memorial Award of Assam Science Society for the year 2005 awarded to Dr B S Dileep Kumar, Scientist for his significant contributions in Life Sciences, Y S Murthy Medal of the Indian Botanical Society (IBS) for the year 2005 awarded to Dr B S Bhau, Scientist, Best Research Paper Presentation Award of the Second International Congress of Chemistry and Environment awarded to Dr B G Unni, Scientist F and Prof M L Narashimhan Merit Award of the Indian Phytopathological Society for the year 2005 awarded to Ms Swarnalee Dutta, a research worker of the laboratory. Dr Utpal Bora, SRF got a Fellowship from the Japan Society for Promotion of Science (JSPS) for undertaking Post Doctoral studies at Medicinal Chemistry Laboratory of Gifu Pharmaceutical University, Japan.

RRL JORHAT AT A GLANCE: 2005-2006**Resource Base**

R & D Department	- 14
Branch Laboratory	- 1
Field/Sub-stations	- 1
Human Resources	
Total S & T Staff	- 322
Scientist (Gr IV)	- 92
Technical (Gr III)	- 76
Technical (I+II+V)	- 154
Total Administrative Staff	- 109
Financial	
	Rs in crores
Govt allocation	- 16.3960
Contract R&D & Consultancy	- 3.1890
Testing / Analytical services	- 0.0810
Miscellaneous	- 0.0020
Royalty / Premia	- 0.0010

Budget : 2005-2006

	Sanctioned (Rs in lakh)	Expenditure (Rs in lakh)
Recurring	1184.497	1184.481
Capital	134.370	134.321
Network Project		
Non-Recurring	122.260	122.260
Recurring	145.971	127.636
Total	1587.098	1568.698

R&D Performances : 2005-2006

Contribution to economy

Contribution to economy	Rs in Crore (Approx)
Industrial production based on RRL Jorhat Knowhow	- 110
Science Output	
(a) Papers Published	
International	- 65
National	- 30
Chapters in Book	- 01
Proceedings	- 23
Average Impact Factor	- 1.866
(b) Paper Presented	- 69
(c) Ph D Awardee	- 12
Technological Output	Number
Process released to industry	- 01
Process commenced production	- 01
Extramural S&T Human Resource Development	Number
Women Scientist	- 03
Research Associate (CSIR)	- 03
Research Associate (Project)	- 01
Sr Research Fellow	- 09
Jr Research Fellow	- 05
Jr Research Fellow (Project)	- 04
Project Assistant	- 57
Guest Worker	- 12
Teacher Fellow	- 02

Resource Mobilisation	Rs in Crores
External Cash Flow	- 3.273
Contract Value of Projects	
Contract Research	- 2.231
Consultancy	- 0.490
Testing/Analysis	- 0.081
Patent Filed	Number
India	- 13
Foreign	- -
Patent Granted	Number
India	- 12
Foreign	- -

Biological Sciences

Study of essential oil composition of Eaglewood trees (*Aquilaria malaccensis*)



The Eaglewood tree *Aquilaria malaccensis* is a precious floral wealth of Northeastern India. The resinous patches of fragrant wood of the plant known as agar in trade has great demand in Egypt, Arabia and throughout the East for use as incense. Agar is considered to be a pathological product and also used for distilling a kind of essential oil called agar attar. It is a vulnerable perfume retainer and attract very high price by the European perfumer for mixing their best grade scent. It is also described as aphrodisiac, cardiatonic, carminative and termed in trade as liquid gold because of its high value. A oil obtained from non-diseased (healthy) wood of the species has been in use amongst the agar wood traders in North East India. Therefore, an investigation was carried out to study the differences in the compositions of essential oils obtained from healthy, naturally infected and artificially inoculated eaglewood

using GC and GC-MS analysis. The study showed a marked difference in the oil composition among the treated woods with regard to their quality.

Valerianol and tetradecanol acid contents were recorded higher in the oils of naturally infected plants in comparison to those of healthy ones. Pentadecanoic acid was totally absent in the oils of healthy plants whereas it was found in a greater amount in the oils of naturally infected plants. In contrast, dedecanoic acid, pentadecanoic acid, hexadecanoic acid and octadecanoic acid were found in higher amounts in the oils of healthy plants, while the oils obtained from naturally infected plants contained lower amounts of these components.

Complementing a novel bacterial genus and species into Microbial Taxonomy from Garampani Hot-spring of Nambor, Assam

A novel bacterial strain designated GPTSA 20T was isolated from Garampani, Nambor of the Golaghat district of Assam which is a hot-spring and was characterized by using polyphasic approach. The cells were Gram-negative, mesophilic, oxidase- and catalase-positive, motile aerobic rods. The fatty acid profile were : C15 0 iso (25.04%), C17 1 iso (1) 9c(19.28%), C16 0 iso (17.73%) and C11 0 iso 3-OH (9.34%). The G+C content was 75 mol%. From 16SrRNA gene sequence analysis (1433 nucleotides, continuous stretch), it was confirmed that the strain GPTSA 20T belonged to the class 'Grammaproteobacteria' and named as *Aquimonas voraii*, gen. nov.sp.nov. The type strain is GPTSA 20T (=MTCC 6713 T =JCM 12896 T. The exploratory work is a significant contribution on basic microbial taxonomy and also for enriching national Gene Bank from Indo-Burma mega biodiversity hot zone. This is a part of joint collaborative work of IMTECH, Chandigarh and RRL-Jorhat.

Search for novel metabolites from microbial endophytes

Isolated 7 strains of endophytic fungi and Streptomyces from medicinal plants of Tawang, Bomdila, Arunachal Pradesh at 12000 ft. altitude and the potential metabolites showing antimicrobial activity in the preliminary screening were put into structure elucidation through HPLC-DAAD assay, NMR spectroscopy. Partial sequence of 16srRNA gene and related assay to determine their entity was in progress.

Release of Partial sequence of 16sRNA genes to NCBI Gene Bank, Bethesda, USA

Partial sequence of 16srRNA gene of following functionally important strains were released to NCBI Gene Bank, Bethesda, Maryland, USA. The work was carried out in collaboration with IGIB, New Delhi. The work was a part of exploratory work on microbial diversity of NE India to explore and enrich the national gene bank from the untapped gene pool of Indo-Burma hot zone.:

1. DQ299944

Streptomyces rimosus strain RRLJ A Y-1 16S ribosomal RNA gene, partial sequence gi/83317141/gb/DQ299944.1/[83317141]

2. DQ299945

Bacillus pumilus strain RRLJ SMAD 16S ribosomal RNA gene, partial sequence gi/83317142/gb/DQ299945.1/[83317142]

3. DQ299946

Paenibacillus lautus strain RRL AY-2 16S ribosomal RNA gene, partial sequence gi/83317143/gb/DQ299946.1/[83317143]

4. DQ299947

Pseudomonas beteli strain RRLJ SMAR 16S ribosomal RNA gene, partial sequence gi/83317144/gb/DQ299947.1/[83317144]

5. DQ166950

Streptomyces sp. SM-1 RRLJ, 16S ribosomal RNA gene, partial sequence gi/74058446/gb/DQ166950.1/[74058446]

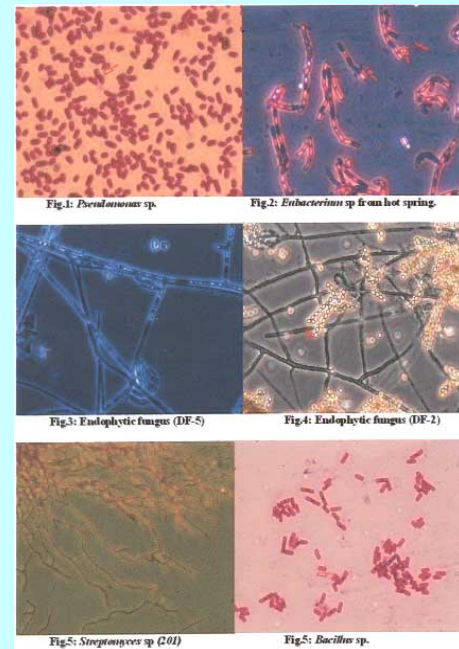
Development of microbial inventory/database

The work on development of microbial database/inventory of the strains being isolated and characterized by the laboratory from Indo-Burma hot zone having important functionalities was in progress. The database would provide the basic information about the strains' morphology, collection data, important biochemical characters, etc. The database would be published in phase manner in the form of a monograph which is considered as an important aspect of biodiversity study.

Isolation, Identification and Characterization of Antibacterial proteins from Muga Silkworm *Antheraea assama*

The flacherie disease has been causing considerable damage to the silkworm, especially the muga *Antheraea assama*. A bacterial strain was identified as the pathogenic *Pseudomonas aeruginosa* strain AC-3 that causes the disease in muga silkworm *Antheraea assama*. The antibacterial proteins were isolated from haemolymph of heat killed bacterial AC-3 injected pupae and subjected to 15% non SDG-PAGE and parallel experiments for antibacterial protein isolation were performed with column chromatography (Sephadex G-75) and HPLC using C-18 column. The fractions isolated were freeze dried and analyzed by LS-MS. It was found to be a positively charged protein molecule having molecular weight 23 kDa. The purified fractions from pupae haemolymph were collected in large quantity, lyophilized, hydrolyzed and subjected to the Water-Pico-Tag amino acids analysis system. A total of 13 amino acids namely Aspartic acid, Glutamic acid, Glycine, Arginine, Threonine, Alanine, Proline, Valine, Cystine, Isoleucine, Leucine, Phenyl alanine and Lysine were detected. Among these, the molar concentration of Glycine, Alanine, Arginine, Lysine and Proline were found to be more in comparison to other amino acids. Studies related to larval survivability, visible cell count and peak immune response was also carried out.

International collaborative programme on drug discovery from Actinomycetes proposed



An international composite project on 'Drug discovery from *Actinomycetes*' against neglected bacterial and parasitic diseases was submitted to European Commission under Specific Targeted Research project scheme for financial support. The aim of the programme is to develop new drug entities against dominant and neglected nosocomial and parasitic infection prevailing in the Asian countries. The participating international R&D group involved were Tübingen University and Berlin University, Germany, RRL-Jorhat, Assam, University of Malaya, Malaysia, Kasetsart University, Thailand, Swiss Tropical Institute, Switzerland, GNRC Ltd., Guwahati and University of Newcastle upon Tyne, UK.

Plant tissue culture and molecular biology

Micro propagation protocol through axillary shooting was developed for pitcher plant, *Nepenthes khasiana*, a highly endemic and endangered plant. Rooting in the in-vitro formed shoots was initiated. DNA finger printing works on *Machilus bombycina*, *Zanthoxylum* spp. collected from different location of North East India was in progress. Two batches of cell culture of *Panax quinquelolium* in Bioreactor produced secondary metabolite particularly ginsenosides to a desired quality.

Accessions of *Cymbopogon flexuosus*

Accessions of *Cymbopogon flexuosus* Nees (Steud) collected from different geographical habitat of North East India, exhibited distinct pattern of internodes length as well as growth of suppressed portion. This phenotypic variability in relation to internodes indicate different strain. 4 accessions showed single growth peak having 4-5 internodes for accelerated phase, whereas other accessions showed two growth peaks consists of 1-2 internodes.

Study of composition of essential oil in various plant species

Composition of *Cinnamomum pauciflorum* leaf essential oil found to differ from *Cinnamomum verum* and *C. cassia* by the presence of three components, one aldehyde and two diterpenes consisting only 0.3% of the total oil. Marked differences in the compositions of essential oils obtained from healthy & naturally infected strain was observed in *Aquilaria malaccensis* (Eagle wood tree) wood. Valerianol and tetradecanoic acid were recorded higher in the oil of naturally infected plants than that of healthy one. Pentadecanoic acid was totally absent in the oil of healthy plants, but dodecanoic acid, hexadecanoic acid and octadecanoic acid is found in higher amount in comparison to naturally infected plants.

Ethnobotanic studies

Information on the usage of 50 plant species by Shyam communities of Assam represented by 62 prescriptions and 15 broad ailments were recorded. For each plant species, local names, medicinal uses, parts of plant used, forms of preparations and applications and their use in particular ailments was documented.

Agro-practices for propagating *Lentinus edodes*, commonly called Shiitake mushroom, was developed. This species fetched good prices for its medicinal and was found suitable nutritional values and suitable to grow in hilly region.

Study of root rot disease

Root rot the causal organism of wilt disease of *Withania somnifera* was identified as *Fusarium solani* which caused 30-50% mortality. Work to control this disease was in progress.

Study for yield of higher biomass

Determination of optimal parameters for production of higher biomass of *Aquilaria agallocha*, *Cymbopogon citratus*, *C. Jawarancusa*, *Litsea cubeba*, *Asparagus racemosus*, *Bacopa moneirri* was continuing.

Plant extract for bioactive molecules

Under the project "Development and commercialization of bioactive and traditional preparation", 1500 plant extracts and lead extractives were taken up for agro bio evaluation against designated target insects under toxicity, feeding deterency and ICR studies. 6 extracts were confirmed to have possessed with promising activities by repeat screening.

89 samples were collected. Among these, 51 herbarium specimens were sent to NBRI, Lucknow, seed samples of 39 species sent to CIMAP and 89 plant samples to RRL Jammu.

Evaluation of *Jatropha* accessions

In a NMI TLI project for genetic improvement of *Jatropha curcas* for adaptability and oil yield, RRL Jorhat collected 15 accessions from geographically distinct habitats of N E India which were found to contain fatty oil from 25 to 36 percent. Elite accessions from different regions viz. U P, Gujrat, Andhra Pradesh, Tamilnadu, Hariyana, West Bengal, Orissa, etc. were also collected and planted to evaluate their performance under agro-climatic conditions of N E India.

Cuttings of native stock were collected and sent to ten different institutes of India for evaluation. Further work was in progress.

Search for Chemotypes of *Litsea cubeba* from North East Indian Germplasm for exploiting high quality essential oil of commercial utility



Litsea cubeba plant collected from NE Indian germplasm indicated wide variation in terms of essential oil percentage. Among the fruit & leaves collected from different N E States, the samples collected from Zoram, Arunachal Pradesh contains high percentage of essential oil in leaves (2.1%) and 4.0% in fruit. On the basis of chemical constituents of oil four major chemo types of *Litsea cubeba* were identified. These were (1) Citral type (2) Linalool type (3) Sebinene type and (4) Citronellal type.

New method for propagation of *Piper longum*

A new method was developed by the RRL Branch at I tanagar for propagation of *Piper longum* from 'Single leaf' instead of 'two nodal cuttings' usually in practice. Growth and yield data of first year indicated

no difference in the yield of fruits between single leaf cutting and noddal cutting. This simple and low cost technique will facilitate rapid and mass generation of *Piper longum* plantlets in rural areas.

Development of new strain of lemongrass



BLI Arun 3 yrs old

Field view of 3 month old plantation of BLI Arun

A new strain of Lemon grass *Cymbopogon flexuosus* BLI -ARUN was developed by RRL Branch, I tanagar. This strain recorded 40-44 tons and 80-87 tons of biomass (FWB)/ha during 1st and 2nd year respectively with 0.77 to 0.88% essential oil and 85.6-88.9% citral. The essential oil yield was 246kg/ha and 497kg/ha during 1st and 2nd year respectively. The strain was made ready for release to farmers.

Development of high value medicinal and aromatic plants for Arunachal Pradesh

Efforts were on to introduce and develop various high value medicinal and aromatic plants for setting up agro-industries in Arunachal Pradesh. During the year under report, the RRL-Branch at I tanagar introduced, acclimatised and multiplied *Stevia rebaudiana* in Arunachal Pradesh. Considerable amount of planting materials were generated and supplied to ST farmers of Arunachal Pradesh. Work was in progress for screening higher stevioside containing clones.

A two year experiment on spacing cum harvesting time of *Kaimpferia galanga* was conducted of RRL Branch and the experiment revealed that harvesting time 18 months with spacing of 20 x 20 cm was the most cost effective. The branch conducted an experiment to find out comparative yield performance of *Kaimpferia galanga* using vermi compost, FYM, NPK alone and their combinations for 18 months duration. It was found that vermicompost @ 2 tonnes/ha was the most cost effective and advantageous in comparison to others.

Chemical Sciences

(Material sciences)

Modified clay catalysed Friedel-Crafts reaction of phenol with 4-hydroxy-butan 2-one to produce 4-(4'-hydroxyphenyl)butan-2-one (Raspberry ketone)

Industrially important organic molecule such as 4-(4'-hydroxyphenyl)butan-2-one also known as "Raspberry Ketone" is used in perfume industries, food industries and also in compositions for weight loss with improved taste. Raspberry ketone is commercially produced by alkylation of phenol with vinyl ketone or 4-hydroxybutan-2-one in presence of hazardous acid catalysts, such as H_2SO_4 and HCl or cation exchange resin or by biocatalyst oxidation. Different Mn^{+} -Mont were reported as catalysts for alkylation of phenol with 4-hydroxybutan-2-one to produce the compound with limited efficiency. There are also reports of use of different types of modified zeolite, H-beta zeolites and other solid catalysts, but the process could not show high efficiency. A process has been developed to produce 4-(4-Hydroxyphenyl) butan-2-one using modified supported clay (Montmorillonite) as solid acid catalysts where about 80 % selectivity and 40 % conversion were achieved. The surface area (BET), oxidic compositions, thermal characteristics, crystallinity (XRD) etc. of the catalysts were determined. The reaction products were characterized by GC, NMR, IR, HPLC and elemental analyses. Further optimization and scale-up studies are in progress.

Cleaning of high sulphur N E coals

Jigging of Assam coal (-10 + 1 mm) from Tikak Colliery was carried out in plain water as well as in presence of additive using -10 +6.3, -6.3 + 4.0, -4 + 1.0 and -10 + 1 mm fractions). The results showed that additive could remove significant amount of mineral matters over water washing from feed coal. Middlings from additive washing may be blended with the concentrate to obtain high yield (70%) with lower ash content (2.5 - 3.5 %).

X-Ray analysis of graphene layers of Assam coal

Coal is widely differing natural rock that consist primarily of organic materials admixed with smaller quantities of mineral matter including sulphur. The organic materials in coal derived from complex plant materials by complicated chemical and biological reaction processes are mainly composed of large polymeric molecules where chemical structures are variable and non-repetitive. Thus the properties of coal depend mainly on the physical and chemical structures of these organic compounds. The tertiary coal occurs in the Eocene and Oligocene strata in Assam. The nature of the organic constituents of Assam coal has been of interest for many years and has been currently of special importance owing to the structure of these coals. The stacking of the *lamellae* (graphene) in coals produce intense peaks, which are dominant features in the X-ray diffractogram, obtained from coals. The diffractogram of coal may be sensually divided into two regions of reciprocal space, the medium S region ($1 < S < 3A$) and a high S region ($S > 4p$) where $4A \sim 1 \text{ Sin} \theta$. Random layered structure of Tikak coal from Assam was studied using X-ray diffraction technique. XRD of the coal sample showed that it is amorphous in nature. Random layered structure analysis showed that the mean lamellae diameter value for L_a and L_c were found to be 49.160 and 12.345A respectively. The internal distance was found to be 3.09A. The position of d-band was found to be 4.34A. The average number of carbon atoms (N) per aromatic graphene and the number of layers were found to be 16 and 4 respectively.

Proximate, ultimate and ash analysis of the coal sample were also carried out.

Development of a new analytical method for estimation of Diosgenin

The laboratory developed a new method for the estimation of Diosgenin, the raw material for the production of 16-DPA which is starting material for various steroidal hormones. Based on the estimation of D5 unsaturation the developed procedure could work as a cheap method for commercial screening of technical grade diosgenin. The method could be adopted in a classical laboratory and the analysis time was found to be significantly less compared to the previously known methods.

HPLC method of ergot alkaloids developed

Effective analysis of the various ergot alkaloids is often difficult. The laboratory developed a HPLC method which was successfully employed to separate all the compounds with excellent peak shape. The compounds were Agroclavine, Lysergene, Lysergine, Festuclavine, Pyroclavine, Ergocornine, d-Ergocryptine and Ergocristine.

Ion pair formation and Hofmeister effects in electrolyte solutions

The ultrasonic velocities, densities, viscosities, and electrical conductivities of aqueous solutions of magnesium nitrate and magnesium acetate were measured from dilute to saturation concentrations at $0 \leq t/^{\circ}C \leq 50$. The temperature derivative of the isentropic compressibility, k_s , became zero at 2.28 mol kg⁻¹ and 2.90 mol kg⁻¹ for Mg(OAc)₂ and Mg

(NO₃)₂ solutions, respectively, at 25°C. The total hydration numbers of the dissolved ions were estimated to be, respectively, 24.3 and 19.2 at these concentrations. Differences in *k_s* for various M₂⁺ salts, using the present and literature data, correlated with reported M₂⁺-OH₂ bond lengths and to a lesser extent with cationic charge densities (ionic radii). The influence of anions on *k_s* appeared to follow the Hofmeister series and also correlated approximately with the anionic charge density. Substantial differences between Mg(OAc)₂(aq) and Mg(NO₃)₂ (aq) occurred with respect to their structural relaxation times (derived from compressibility and viscosity data) and their electrical conductivities. These differences were attributed to much greater ion association in Mg(OAc)₂ solutions. Raman spectra recorded at 28 °C confirmed the presence of various types of contact ion pairs including mono- and bidentate complexes in Mg(OAc)₂(aq). In Mg(NO₃)₂ (aq) only non-contact ion pairs appeared to be formed even at high concentrations. The experimental results were supported by molecular dynamics simulations, which also revealed the much stronger tendency of OAc⁻ compared to NO₃⁻ to associate with Mg₂⁺ in aqueous solutions. The simulations also allowed an evaluation of the ion-ion and ion-water radial distribution functions and cumulative sums, and provided a molecular picture of ion hydration in Mg(OAc)₂(aq) and Mg(NO₃)₂(aq) at varying concentrations.

Oxidative addition of different electrophiles with rhodium(I) carbonyl complexes of unsymmetrical bis-(phosphine)monoselenide ligands

Dimeric chlorobridge complex [Rh(CO)₂Cl]₂ reacted with two equivalents of a series of unsymmetrical bis-(phosphine) monoselenide ligands, Ph₂P(CH₂)_nP(Se)Ph₂ {n=1(a), 2(b), 3(c), 4(d)} to form chelate complex [Rh(CO)Cl(PSe)](1a) {PSe = h₂-(P, Se) coordinated} and non-chelate complexes [Rh(CO)₂Cl(P~Se)](1b-d) {P~Se = h₁-(P) coordinated}. The complexes 1 underwent oxidative addition reactions with different electrophiles such as CH₃I, C₂H₅I, C₆H₅CH₂Cl and I₂ to produce Rh(III) complexes of the type [Rh(COR)ClX(PÇSe)] {where R=-C₂H₅(2a), X=I; R=-CH₂C₆H₅(3a), X=Cl}, [Rh(CO)Cl₂(P Se)](4a), [Rh(CO)(COCH₃)Cl(P~Se)](5b-d), [Rh(CO)(COC₂H₅)Cl(P~Se)](6b-d), [Rh(CO)(COCH₂C₆H₅)Cl₂(P~Se)](7b-d) and Rh(CO)Cl₂(P~Se)](8b-d). The kinetic study of the oxidative addition (OA) reactions of the complexes 1 with CH₃I and C₂H₅I revealed a single stage kinetics. The rate of OA of the complexes varied with the length of the ligand backbone and followed the order 1a > 1b > 1c > 1d. The CH₃I reacted with the different complexes at a rate 10-100 time faster than the C₂H₅I. The complexes were characterized by elemental analyses, IR, ¹H and ³¹P NMR spectroscopy.

Monocarbonyliridium(I) complexes of P-Se ligands and oxidative addition reactions

A series of halocarbonyliridium(I) complexes of the type [Ir(CO)(P~Se)2X](1) {where P-Se=1, 2-bis (diphenylphosphinomethaneselenide); X = Cl(1a), Br(1b), I(1c)} were synthesized by the reaction of Ph₄As[Ir(CO)₂I]₂ with the ligand P-Se. The complexes exhibited single ν(CO) band in the region 1926 cm⁻¹ indicating high electron density on the metal centers. The complexes underwent oxidative addition reaction with electrophiles like MeI to form Ir(III) methyl species like [Ir(CO)(CH₃)(P~Se)2I2X] (2) which exhibited ν(CO) bands in the region 2070 cm⁻¹. Kinetic measurements for the MeI oxidative addition with complexes (1) indicated a first order reaction. The complexes (1) and (2) were characterized by elemental analyses, IR, NMR and mass spectroscopy.

Interaction of bulky cationic dyes (Pyronin Y and Rhodamine 6G) with different forms of Montmorillonite clay matrix and characterization of the composites

The surface characteristics of three different states of Montmorillonite clay minerals namely, Na-Montmorillonite (Na-Mont), acid treated Montmorillonite (H⁺-Mont) and K-10 Montmorillonite (K-10 Mont) were studied using two different bulky cationic dyes, PyroninY and Rhodamine 6G as probe molecules. The adsorption of cationic dyes by different forms of Montmorillonite with different concentration ratios of clay and dye were substantiated by visible spectroscopy, X-ray diffraction, infrared spectroscopy, thermal analysis and surface area determination. The visible spectra showed blue shift (metachromasy) of the parent monomeric dye band caused by p-interaction between the dye molecule and surface oxygen of the silicate layers of the clay or dye-adsorbed-dye interaction while the observed red shift was due to the surface polarity. The XRD values of PyroninY and Rhodamine 6G adsorbed on Na-Montmorillonite and acid treated Montmorillonite suggested the formation of monolayer of dye molecules in the interlamellar spacing. The surface areas of different dye adsorbed clays were invariably reduced indicating interlamellar spacing of the layered matrix (Na-Mont) as well as pores of K-10 Mont are partially occupied with the dye molecules.

Adsorption of small organic aromatic acids on oxide surfaces

Kinetics of adsorption of benzoate and phthalate on α-alumina surfaces were performed at constant ionic strength, I = 5 × 10⁻⁴ mol dm⁻³ and pH 5 at 25, 30 and 40 °C. Kinetics results showed that the rate of adsorption of phthalate was

~2 times more than that of benzoate on α -alumina surfaces at 25°C. The adsorption of benzoate and phthalate on α -alumina surfaces were carried out over a wide range of concentration of adsorbate at fixed ionic strength, $I = 5 \times 10^{-4} \text{ mol dm}^{-3}$ and pH 5-10. The adsorption isotherms for both the systems were found to be Langmuir in nature. The maximum adsorption density of phthalate was 1.1-5.1 times more than that of benzoate on the same adsorbent under similar condition. This difference is attributed to the presences of adjacent -COOH group in phthalate. The activation energy for both the system was calculated using Arrhenius equation. The other thermodynamics parameters like Gibbs free energy, enthalpy and entropy were also calculated. The solubility of α -alumina in presence of benzoate and phthalate was found to be depended on the pH of the medium and the concentration of sodium chloride. The surface complexation of benzoate and phthalate on α -alumina surfaces were investigated using the Fourier transform infrared (FTIR) spectroscopy. Benzoate formed outer-sphere complexes with α -alumina surfaces at pH 5 and 6 depending on the shifting of the asymmetric and symmetric bands. Whereas phthalate formed both outer-sphere and inner-sphere surface complexes with α -alumina surfaces.

Characterization of limestone resources of NE Region for value addition and rational utilization

Beneficiation of limestone from New Umrangshu (North Cachar Hillss, Assam) was investigated by dry and wet grinding followed by size separation. The coarse fraction (-25 mm +18.75 mm) contained maximum amount of CaO (~52%) and minimum amounts of SiO₂ (1.53), Al₂O₃ (0.79%) and Fe₂O₃ (0.68%). The fine fraction (-12.5 mm) contained the minimum amount of CaO (50.92%) and maximum amount of SiO₂ (2.25%), Al₂O₃ (0.93%) and Fe₂O₃ (1.32%). Most of the kaolinite clay mineral concentrated in the fine fraction. The limestone might find use as a fluxing material in metallurgy and raw material for manufacturing lime required in manufacturing of sugar, soda ash, caustic soda, water treatment etc. It was possible to obtain a fraction having more than 54% CaO with low SiO₂ (~0.5%), Al₂O₃ (~0.6%) and Fe₂O₃ (~0.7%) by further grinding the lime stone followed by separation by dispersion-cum-settling technique. The work was funded by Ministry of Mines, New Delhi.

Alkali activated blended cements: Mechanical strength, pore solution composition and zeolite formation

The effect of sodium hydroxide, sodium carbonate, sodium sulphate and sodium silicate on the lime reactivity of metakaolin was investigated as per Indian Standard methods. The hydration products were separated by dispersion cum sedimentation technique and the same were characterized. The strengths of the mortar cubes were affected by the nature and concentration of the alkali/salt. The work was funded by Ministry of Water Resources, Research & Development Division, New Delhi.

Evaluation of bench scale conditions of preparation of Mixed-Metal Hydroxide and suitability of it as drilling fluid additive for drilling operations of OIL

The suitability of Mixed Metal Hydroxides prepared in the laboratory was evaluated as viscofier for clay based drilling fluid of OIL using clay supplied by OIL Duliajan. Results obtained showed that the less than 1 mm fraction content in clay was extremely important for MMH to work as viscofier. MMH, being an inorganic environmentally benign and economically cheap material is a suitable product for oil industry for using as a viscofier in normal drilling operations. The steps involved in its preparation are not very complex. Therefore, the project on successful completion bore prospect for successful commercialization. The work was carried out under a collaborative project funded by OIL, Duliajan.

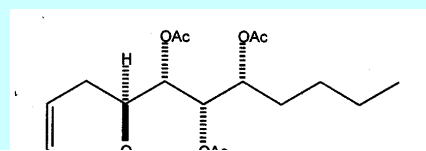
Natural Products

Bioactive Molecule

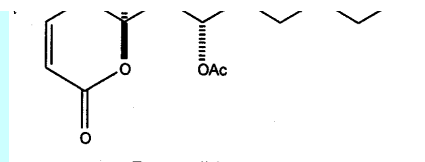
In a CSIR coordinated project on development & commercialization of bioactive molecules from plant sources a total of 16 number of plants and 16 number of plant parts were extracted with three different solvents and a total of 47 number of extracts made. These extracts were sent to different bioevaluating laboratories for screening against different diseases. Out of the extracts sent earlier a total of 3 number of extracts showed promising bioactivity and accordingly 2 number of repeat samples were sent for confirmation of the bioactivity. Two samples bearing codes RJO342P01A001 and RJO1923P13A001 exhibited strong antimalarial activity in vitro and on request of the bioevaluator repeat extracts of these plants were sent. Under single molecule discovery scheme a total of 9 pure single molecules were sent for bioevaluation. Out of these samples, RRLJ-Dan/Eto exhibited anti-gastric ulcer activity and sample RRLJ-Dan/Ac exhibited anti-Parkinson's activity. Repeat samples were sent recently for further study.

Total Synthesis of Natural Products

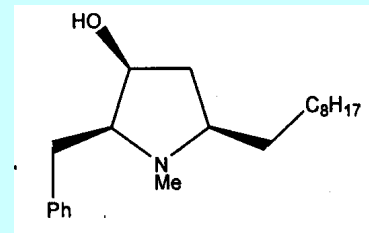
(+)-Boronolide, an α , β -unsaturated d-lactone containing a polyacetoxy side-chain isolated. *Tetradenia fruticosa* is known to possess antimalarial property; a



stereoselective total synthesis of this molecule was accomplished, the key steps were Sharpless asymmetric dihydroxylation, Shibasaki's asymmetric Henry reaction, asymmetric allylation and ring closing metathesis.

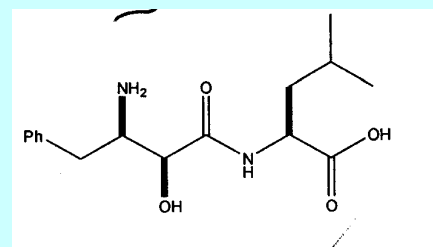


A concise synthesis of the pharmacologically important natural product (+)-preussin was achieved. Two asymmetric C-C bond-formation reactions mediated by binaphthol-derived asymmetric catalysts were applied to control the stereochemistry of its three stereocenters.

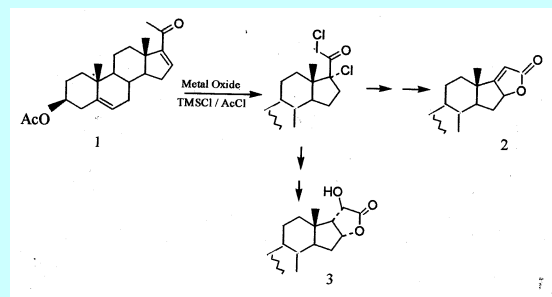


The piperidine alkaloid (+)-sedamine has long been used for the treatment of narcotic poisoning, coal gas asphyxia, pneumonia and control of anxiety as folk medicine in the Indian subcontinent in crude form. This molecule was synthesized utilizing two regioselective ring-opening reactions of epoxide with vinyl metallic reagent and a ring closing metathesis reaction as the key steps.

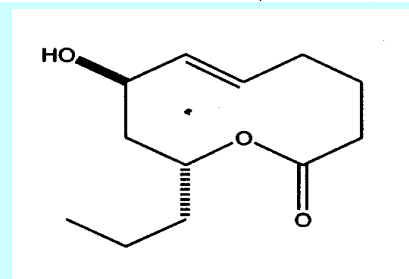
A total synthesis of the aminopeptidase inhibitor (-)-beststin was achieved involving asymmetric nitro-aldol reaction as the key step.



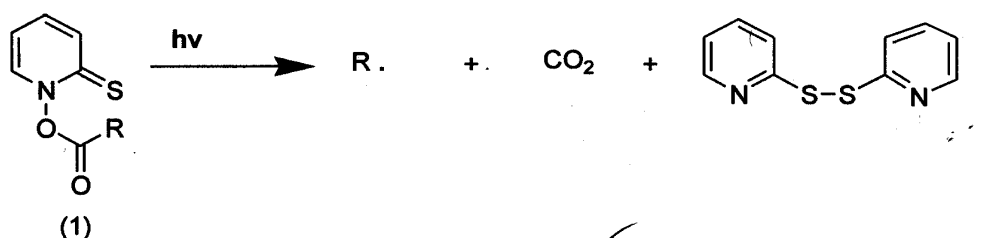
The chemistry of steroidal lactones is of great interest as many of this class of compounds were potent antitumor agents. Metal-mediated halogenation technique was used as a key step to synthesize D-ring fused 16- α -steroidal- γ -butyrolactones 2&3 from 20-oxopregnane 1.



The phytotoxic lactone herbarumin III was synthesized in 11% overall yield. The approach applied involved, Keck's asymmetric allylation and Sharpless epoxidation to build the key fragment. Esterification with known acid and a ring closing metathesis was used to arrive at the target.



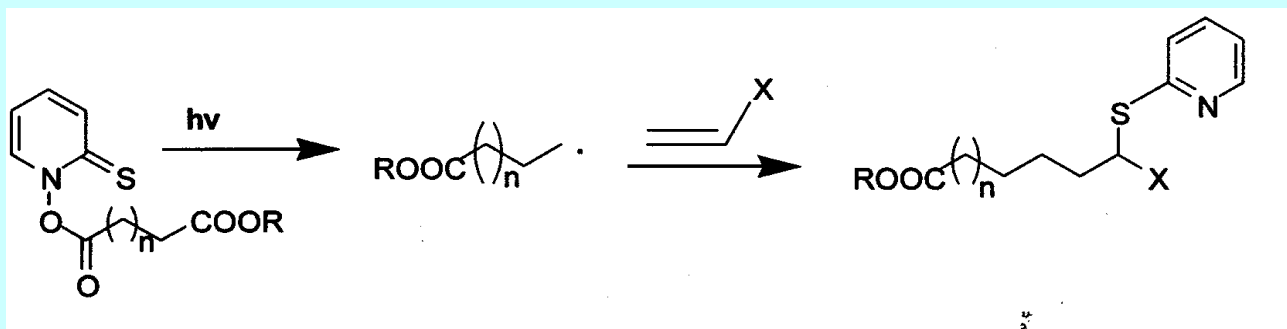
New Chemistry Developed



Acyl derivative of N-hydroxy-2-thiopyridone (1) popularly known as 'Barton ester' is a good source of alkyl radical.

A study was carried out to generate substituted alkyl radicals from dicarboxylic acids or from acids of complex stereo structures. Further study would be about its use in carbon-carbon bond formation reaction.

Use of non-conventional energy source such as microwave energy, sunlight, etc. was being exploited in the course of the reactions.

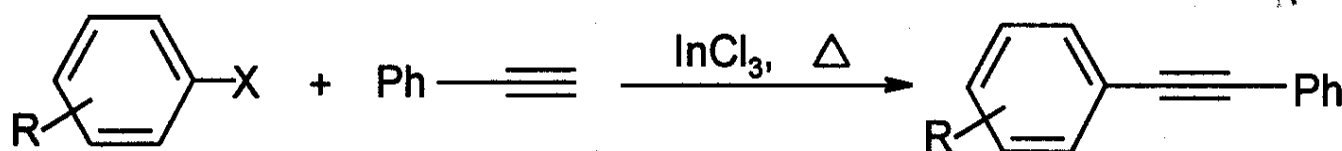


Mild and efficient indium

(III) chloride catalyzed Sonogashira coupling reaction of aryl halides

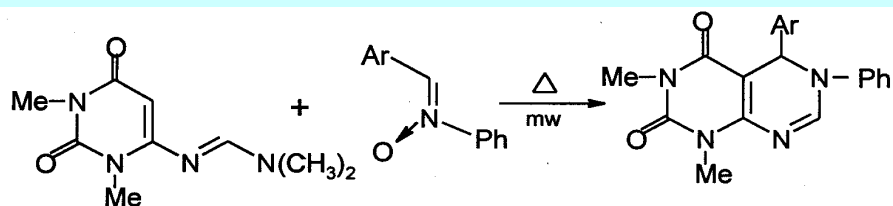
Over the past twenty five years, the Sonogashira coupling of terminal alkynes with (hetero)aryl halide has been a most attractive and powerful tool for the preparation of terminal and internal alkynes in organic synthesis. This reaction proceeds in the presence of a homogeneous palladium/phosphine/copper salt catalytic system, which makes the recovery of the metal tedious if not impossible and might result in high palladium contamination of the product. A ligand-, copper- and amine- free Sonogashira reaction was also reported.

However, the copper and amine-free methodologies require high palladium catalyst loading, palladium complexes or ligands, which were expensive and hard to synthesize. In a very recent finding Leadbeater pointed out that his palladium free Suzuki reaction reported earlier actually proceeded using ultra-low quantities of palladium contained in the sodium carbonate. A Mild and efficient indium(III) chloride catalyzed Sonogashira coupling reaction of aryl halides with terminal alkynes to form internal alkynes in high yields was developed in the laboratory. The reaction was effected in the absence of a copper co-catalyst, phosphine ligand and palladium metal. It was assumed that this was first ever report on Sonogashira coupling reaction catalyzed by indium.

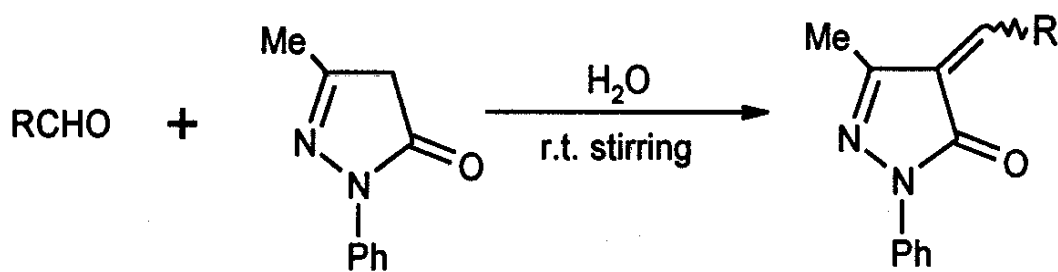


An electron rich substrate 6-[(dimethylamino)methylene]amino uracil undergo (4+2) cycloaddition reactions with various in situ generated glyoxylate imines and imine oxides to give novel pyrimido[4, 5-d]pyrimidines after elimination of 1, 3-dimethylamine from the cycloadducts and oxidative aromatisation.

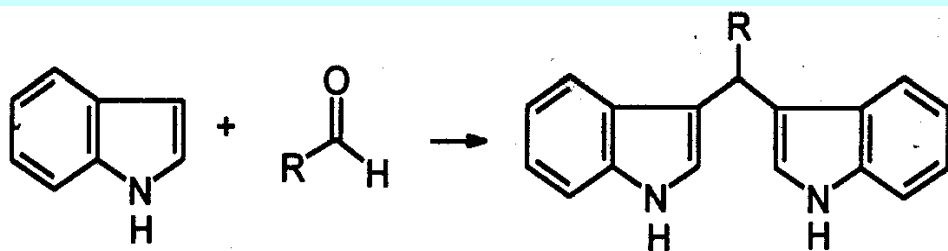
This procedure provides a convenient method for direct synthesis of pyrimido[4, 5-d]pyrimidine derivatives under thermal conditions. These results also illustrate that the novel pyrimido derivatives, as synthesized, are useful substrates for the generation of an array of fused nitrogen heterocycles.



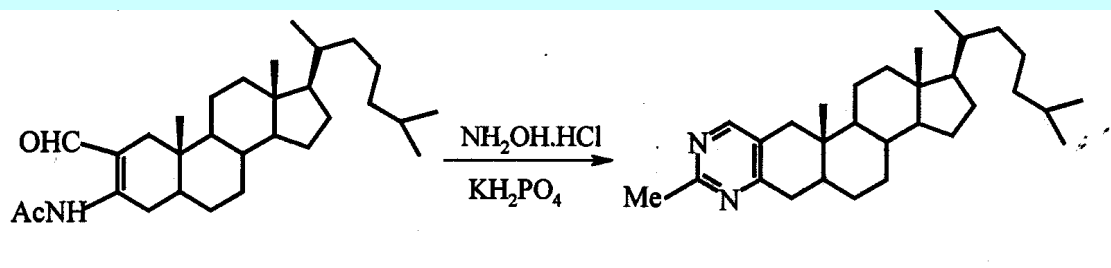
The Knoevenagel condensation of aldehydes with active methylene compounds is an important and widely employed method for carbon-carbon bond formation in organic synthesis with numerous applications in the synthesis of chemicals, hetero Diels-Alder reactions and synthesis of carbocyclic as well as heterocyclic compounds of biological significance. The reactions are usually catalysed by bases such as amines, ammonia or sodium ethoxide in organic solvents. Lewis acids, surfactants, zeolites and heterogeneous catalysts have also been employed to catalyse the reactions. The laboratory developed a very simple and highly efficient method for the condensation of various aromatic and heteroaromatic aldehydes with several active methylene compounds.



Bis(indolyl)methanes, which contain two indole or substituted indole units in a molecule, feature widely in bioactive metabolites of terrestrial and marine origin. Therefore, large efforts have been directed towards the synthesis of these molecules. We have reported the first example of the synthesis of bis(indolyl)methanes from the condensation of various aldehydes and indoles in a protic solvent at room temperature in absence of any added catalyst.



The chemistry of pyrimidine is of great interests because they constitute the basic unit of DNA bases and are also used as antibiotic (blasticidin), CNS depressants (Phanobarbital), antimicrobial (pyrimido-2,4-diamines) and antitumor agents (5-fluoro uracil).



On the other hand, the steroidal heterocycles such as danazol, deflazacort, cortivazol, nevazol, 2-azasteroid and finasteride, attract much attention due to their biological activities against various ailments such as benign prostatic hyperplasia, asthma, prostate cancer and L-1210 leukemia. Because of the biological activities imparted by these heterocycles or steroids, the attention for the preparation of novel A- and D-ring annelated heterosteroids continue to intensify. A novel strategy for the construction of pyrimidine nucleus on steroids using chemistry of β -formyl enamide was developed and the reaction was generalized by employing various A- and D-ring steroidal, alicyclic and acyclic formyl anamides.

Development of Green Chemistry :

I_2 /surfactant/water system deprotecting oximes and imines to the corresponding carbonyl compounds under neutral conditions in water

In recent years, development of environmentally benign methods/reagents received attention from chemists, because of the conservation of global eco-system. Water is an environment friendly solvent. It is cheap, readily available and non-toxic with high dipole moment. Therefore, the development of new methodology in water is necessary for conservation of environment. However, the main hurdles in using water as a solvent are (1) most of the organic reagent/catalysts are insoluble in water (2) the moisture sensitive reactants/catalysts cannot survive in water. To overcome these hurdles, a surfactant in water is an appropriate candidate for solubilizing the organic reactants/catalyst and maintaining an anhydrous environment for moisture sensitive reagents and performing the reaction in water. In this endeavour, a selective oxidation of oximes and imines to carbonyls under neutral conditions in water was undertaken and performed successfully. Here, the surfactant solubilized water insoluble I_2 and organic reactants in water and selectively deprotected imines and oximes to carbonyls. No over oxidized product i.e. acid was detected in the reaction mixture. The concept could be applied to R&D/technology development.

(a) Surfactant/ I_2 water

An efficient system for deprotection of oximes and imines to carbonyls under neutral conditions in water. The system was used for deprotecting a range of oximes and imines to the corresponding carbonyls under neutral conditions in water at $[25-40]^\circ\text{C}$ with high to excellent yield.

(b) Conversion of alcohols to aldehydes and ketones using I_2 -KI - K_2CO_3 - H_2O system

A new system, I_2 -KI - K_2CO_3 - H_2O , which selectively oxidized alcohols to aldehydes and ketones under anaerobic condition in water at 90°C with excellent yield was developed. The process is green, mild and inexpensive. The selective oxidation of alcohols to carbonyls is an important transformation in organic synthesis. This transformation uses organic solvents, transition metals, air/ O_2 , toxic oxygen containing oxidants, etc. To overcome these classical hurdles, a new reagent system [$\text{KI}/\text{I}_2/\text{K}_2\text{CO}_3/\text{Water}$] which avoids organic solvents, transition metals, air/ O_2 , toxic oxygen containing oxidants, etc. was developed. The process is clean, anaerobic and economically viable.

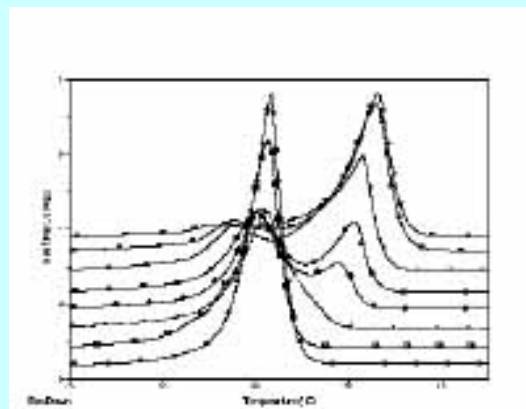
Petroleum Products

Development of specialty polymers for use in Petroleum and Allied Industries

Work was undertaken for the development of specialty polymers by Controlled/Living radical Polymerization for use in Petroleum and Allied Industries with the aim of developing tailor made polymeric additives by transition metal catalyzed living radical polymerization technique for use as additives for crude oils and petroleum products.

Cocrystallization Behavior of Poly(n-Docosyl Acrylate) with n-Docosanoic Acid by X-ray and Differential Scanning Calorimetry Studies

Cocrystallization of comb-like poly(n-docosyl acrylate) (PDA) with n-docosanoic acid (C_{22}) have been studied by differential scanning calorimetry (DSC) and X-ray diffraction (XRD) methods. DSC measurement of PDA/ C_{22} blends showed the characteristic melting endotherms and also suggested the existence of another crystalline form induced by the addition of the C_{22} . The existence of hexagonally-packed crystalline lattice and the phase behavior of PDA/ C_{22} blends were established from XRD studies. Thermal degradation behavior of PDA/ C_{22} blends were performed by thermogravimetric analyzer.



Kinetic Study of the Atom Transfer Radical Polymerization of n-docosyl acrylate

The atom transfer radical polymerization (ATRP) of n-docosyl acrylate (DA) was achieved by using the carbon tetrabromide/ $FeCl_3$ /2,2'-bipyridine (bpy) initiator system in the presence of 2, 2'-azobisisobutyronitrile (AIBN). The linear relationship between molecular weight of the resulting poly(n-docosyl acrylate) with conversion and narrow polydispersity of polymers indicated the living characteristics of polymerization reaction. The significant effect of AIBN on the ATRP of DA was observed and a probable reaction mechanism for the polymerization system was postulated to explain the observed results.

Synthesis of Comb-Like Polymers by Atom Transfer Radical Polymerization

Effect of various $Fe(III)$ species on the conventional and reverse ATRP systems was successfully achieved and probable reaction mechanisms were proposed to explain the observed results. In accordance of the mechanism of ATRP, analysis of tacticities indicated normal stereoselectivity of polymers with n-alkyl side chains. Thermodynamic parameters of polymers were dependent on the alkyl chain length of the monomers.

Development of water soluble polymer/copolymer for enhanced oil recovery

It is desirable to reduce permeability of the water channels of oil reservoirs when they start to produce more and more quantities of water in addition to crude oil. Generally water soluble polymers are injected to the reservoir to reduce the permeability of water without affecting the permeability of oil. The polymers injected into the formation behave differently in different formations and it is necessary to understand the behaviour of the formations towards the polymers being used. Process for the preparation of thermally stable brine compatible cross-linked polymer were under development. The compound was identified and the process parameters were studied.

A novel Indium-catalyzed Sonogashira coupling reaction, effected in the absence of a copper salt, phosphine, ligand and palladium

An efficient copper, phosphine, ligand and palladium-free indium-catalyzed Sonogashira coupling reaction was developed. In the presence of 1 mol% indium trichloride, coupling of various aryl halides with terminal alkynes afforded the corresponding aryl alkynes in moderate to excellent yields. Over the past twenty five years, the Sonogashira coupling of terminal alkynes with (hetero)aryl halide has become a most attractive and powerful tool for the preparation of terminal and internal alkynes in organic synthesis. This reaction proceeds in the presence of a homogeneous palladium/phosphine/copper salt catalytic system, which makes the recovery of the metal tedious if not impossible and might result in high palladium contamination of the product. A ligand-, copper- and amine-free Sonogashira reaction has also been reported. However, the copper and amine-free methodologies require high palladium catalyst loading, palladium complexes or ligands, which were expensive and hard to synthesize. The laboratory developed a mild and efficient indium(III) chloride catalyzed Sonogashira coupling reaction of aryl halides with terminal alkynes to form internal alkynes in high yields. The reaction was effected in the absence of a copper co-catalyst, phosphine ligand and palladium metal. The present methodology was simple to perform, efficient and did not involve the use of expensive reagents or catalysts. Due to the operational simplicity as well as easy isolation and purification procedures for the products, the methodology appeared to be a useful as alternative to the conventional

Sonogashira coupling reaction.

Engineering Sciences

Development of a manufacturing process for Green Tea Polyphenols (GTP) from Assam tea

Tea leaves contain a good amount of polyphenols which act as anti oxidants and can be used as preventive medicine for numerous ailments. In consideration of the vast area of tea cultivation in Assam inclusive of the small tea gardens, comparatively higher content of polyphenols, need for product diversification of tea industry for economic benefit, work on extraction and purification of polyphenols from fresh leaves of Assam tea was undertaken. The bench scale work was progressing well and was expected to be completed within a year.

Nutraceuticals for health and specialty foods through biotechnology approaches

Rice is staple food in many parts of India. Assessment of nutraceutical components, extraction and formulation of the same for health benefits etc. are very important. A project was funded by DBT, New Delhi for the work. Initially anthocyanin and arabinoxylan were taken as target molecules. R&D work was initiated with some specific varieties of rice of the north eastern region of India.

Development of a process for production of liquid fuel from petroleum refinery solid waste of North Eastern Region of India by thermal and catalytic cracking

A huge amount of petroleum refinery solid waste in some refineries of the North Eastern Region of India has been accumulated causing storage and disposal problem as well as a threat to environment. Utilization of this material for converting it into liquid fuel has been planned. A project for this purpose was funded by the Ministry of Environment & Forest for three years and the work was initiated.

Development of enantio-selective membranes from chiral polymers

R&D work on preparation of enantio-selective membrane for resolution of some pharmaceutically important amino acids with good separation factor was done. Based on the results, structure-activity relationship could be made to correlate separation selectivity and permeation rate with molecular structure in terms of hydrophobicity of amino acids. For resolution of racemic alcohols of pharmaceutical importance, a specific chiral selector (cholesterol glutamate) was found to be effective in liquid membrane system where facilitated transport could be exploited to effect the resolution. Based on the gained experience, further work for preparation of enantioselective membrane from chiral polymers was initiated. The enantioselective behaviour of the membrane would be studied for some therapeutically important racemic compounds such as trans-sobrerol, sulbutamol, captapril, sulmeterol, etc.

Predicting behaviour of subsoil of NER of India - a Geotechnical study

The study revealed the following: :

(a) Subsoil are normally classified in various way based on their properties and engineering requirements. Based on origin of their formations subsoil are divided into 4-classes; viz., Laterite i.e. Cratonic origin; Alluvium i.e. Lactustrine origin; Colluvium i.e. Slump origin; and Hard soil -Soft rock. i.e. segregation of sediment in slump origin.

(b) Most of the geotechnical properties and characters are predictable in nature.

(c) Unconfined strength and cohesion of subsoil profile can be predicted with the relationships. developed based on the shear parameters or vis versa.

(d) With the basic index properties field compression index can be evaluated directly from the developed relationships, along with the maximum moisture possession capacity of the fine-grained subsoil.

(e) Preliminary behaviour of Assam alluvium & laterite soil can be predicted based on its colour in wet condition to control huge work under time bound project.

(f) Behaviour of Assam alluvium & laterite subsoil can be predicted based on its basic index properties for all status of project work.

(g) Prediction of historical loading condition of any alluvium is a very difficult task because of presence of sand particles. However, the development new of relationship offers useful solution for estimating the ultimate settlement of any foundation constructed over Assam alluvium & laterite of massive subsoil deposition that, can be predicted based on the developed new process of evaluation & relationship.

(h) All the new developments regarding prediction of behaviour and evaluation of shear parameters without triaxial shear test machine, are found always useful for both laterite soil of India and alluvium of inorganic and contaminated organic soil of Assam & Indo-Gangetic alluvium also.

(i) These developments are not valid for Colluvium soil newly identified and found along the lower Himalayan belt. There were some useful achievements about the determination of the total economic findings of the geotechnical properties of subsoil as design parameters of project structures for timely completion of huge work under project.

Earth Sciences

Complex Tectonic model of Shillong Plateau

The complex tectonic model of the Shillong Plateau, which is the source area of the 1897 great earthquake in the North Eastern Region of India, was examined using the high precision data of a 20-station digital seismic network that is in operation in the Plateau since 2001. The dominating thrust/strike-slip faulting earthquakes in the western Plateau although could be explained by the 'pop-up' tectonic model [Bilham and England, 2001], the seismological data, however, showed that the north dipping Dapsi and the south dipping Brahmaputra faults are the possible boundary faults, not the Dauki and Oldham faults as were proposed in the model. The more intense normal/strike-slip faulting earthquakes in the eastern Plateau (Mikir massif), on the other hand, are generated by a long and deep rooted Kopili fault by transverse tectonics, and this could be the more vulnerable source area for an impending large/great earthquake in the region.

The seismic activity in the western Shillong Plateau reveals that the activity below the Plateau is mostly confined down to a depth of 35 km, and these events are bounded by the two boundary faults. We, however, prefer to infer the north dipping Dapsi thrust (DT) as the southern boundary fault and the south dipping Brahmaputra fault (BF) as the northern boundary fault; these faults are responsible for generating the earthquakes in the western part of the Plateau, and the 'pop-up' tectonic model is conformable with our observations. The Dauki fault is a dominantly strike-slip/normal fault zone, which is evident by a normal faulting solution near the fault zone; although the nodal planes are not conformable with the E-W Dauki fault, but the tensional regime is evident. The fault-plane section fairly reveal the two boundary faults; the fault planes 1 and 2 reflect the north dipping Dapsi thrust, and the fault planes 5 and 27 reflect the south dipping Brahmaputra fault. We believe that the Dapsi thrust could be the southern boundary fault and the Brahmaputra fault could be the northern boundary fault for the 'pop-up' tectonic model. It may be noted that the event 9 occurred at a deeper depth (55 km) in the lower crust in Bengal basin where crustal thickness is much more compared to the thickness found below the Shillong Plateau.

In the Kopili fault zone the seismic activity is more intense, and base of the seismic zone extends down to 45 km. The cross section of the events across the fault zone shows two possible northeasterly dipping faults. The cross-section of the fault planes at depth is fairly conformable with the two dipping faults, one being very prominent for the solutions 15, 18 and 19, and the other is evident with the solution 23 and 16, though other complex fault-plane solutions exist in the zone. The entire Kopili fault zone is, however, dominated by normal/strike-slip faulting, unlike the thrust faulting earthquakes at the Dapsi/Brahmaputra fault zone in the western Plateau where 'pop-up' tectonics is dominated. The Kopili fault zone is believed to extend transversely below the Himalaya which was evident in this study; the solutions 10 and 16, that occurred to the north of Main Boundary Thrust (MBT) in the Himalaya, may be explained by the transverse seismogenic structures.

These data of the digital seismic network are expected to shed new light in our understanding of the Shillong Plateau earthquakes. The 'pop-up' tectonic model is conformable with the seismic activity in the western Plateau, and we identify the DT and BF as the boundary faults for the pop-up tectonics. The Kopili fault zone earthquakes in the eastern Plateau, Mikir massif region, on the other hand, are different; these are caused by the long and deep rooted Kopili fault that is transverse to the Himalayan trend. Both the fault zones, the Dapsi/Brahmaputra and the Kopili fault zones, in the Shillong/Mikir Plateau are intensely active, but their tectonics are different. The Kopili zone is, however, more intensive with higher b-value and higher fractal dimension, and occurrence of an impending large earthquake is speculated in this zone.

Seismic hazard, risk assessment and environmental studies for North - East India.: A Study on attenuation of coda waves in the Northeastern region of India

Coda wave attenuation quality factor Q_c are estimated in the Northeastern region of India using 45 local earthquakes recorded by regional seismic network. The quality factor Q_c was estimated using the single backscattering model modified by Sato (1977), in the frequency range 1-18 Hz. A total of 3890 Q_c measurements covering 187 varying paths were made. Eight lapse time windows of 20, 30, 40, 50, 60, 70, 80 and 90 sec are used. The magnitudes of the analyzed events range from 1.2 to 3.9 and focal depths range between 7 and 38 km. The source receiver distances of the selected events range between 16 and 270 km. For 30 sec coda window length, the mean values of the estimated Q_c vary from 50 ± 12 (at 1Hz) to 2078 ± 211 (at 18Hz) for the Arunachal Himalaya, 49 ± 14 (at 1Hz) to 2466 ± 197 (at 18Hz) for the Indo Burman and 45 ± 13 (at 1Hz) to 2069 ± 198 (at 18Hz) for Shillong group of earthquakes. The Q_c increases with frequency; an average attenuation relation $Q_c = 52.315 + 1.07f^{(1.32 \pm 0.036)}$ is obtained for the region. The pattern of Q_c-1 with frequency is analogous to the estimates obtained in other tectonic areas in the world, except with the observation that the Q_c-1 is much higher at 1Hz for NER. The Q_c-1 is about 10-1.8 at 1Hz and decreases to about 10-3.6 at 18Hz indicating clear frequency dependence. The spatial distribution of Q_c values indicates that Mikir Hills, Arunachal Himalaya and western part of Shillong Plateau are characterized by lower attenuation.

Seismological Data Base for Chedrang Valley, Meghalaya

Seismological data base was prepared for about 1776 earthquakes in Chedrang valley and its vicinity, East Garo Hills, Meghalaya during the period 2004-2005. The database is useful to the assessment of seismic hazard in the Chedrang valley region in Meghalaya.

Attenuation of Coda wave and Waveform analysis Estimation of focal mechanism solutions using P-wave polarity method and waveform inversion technique

An empirical approach to observe the attenuation of coda wave utilizing single scattering model is the basis to develop the attenuation model in NER, India. A set of coda Q_c values were determined from 45 local earthquake events for eight lapse time window at ten frequency bands. These were primarily determined for Arunachal Himalaya, Indo-Burman region and Shillong Mikir plateau cum Assam valley.

An analysis of coda waves at eight lapse time window lengths indicated that Q_c is lapse time dependent in the region. The Q_c values increases as lapse time window increases. On the other hand, value of degree of frequency dependence "n" was found to be higher at lower lapse time. The decrease in the value of "n" for longer lapse time window for each of the three tectonic blocks indicated a strong correlation with tectonic activity. The average Q_c values at each station for the three tectonic blocks showed that at low frequency band they vary marginally as a function of lapse time. Except for a strong local site effect at the station TZR, the Q_c at the other stations were fairly similar, even though the coda waves sample slightly different volumes. Low Q_c values estimated at the TZR station could be due to the separate crustal domain that exists beneath this station. At higher frequency bands the Q_c values increase moderately as a function of lapse time while marginal increments were observed at lower frequency bands. The attenuation at higher frequencies is less pronounced than at lower frequency. The frequency dependent average attenuation parameter for the IBR was found to be lowest. The lowest Q_c value at IBR indicates the probable region for occurrence of large earthquake. The low Q_c value reflects the strong scattering effects of the highly dense faulted structure in the region.

Attenuation pattern shows that western part of the Arunachal Himalaya near Bomdila, eastern part of the Shillong Plateau and parts of upper Assam valley near Jorhat represent higher attenuation than other parts of the region at all the frequencies. The Mikir hills, Arunachal Himalaya and western part of the Shillong plateau are characterized by lower attenuation best outlined at 6Hz.

Determinations of focal mechanism solutions were obtained by using P-wave polarity method and waveform inversion technique. Earthquakes with magnitude above 3.5 were used for P-wave polarity method that is able to produce the focal mechanism solutions but not the seismic moment. Waveform inversions of eleven local earthquake events are able to produce the source parameters, seismic moment and moment magnitude. Significant phases like P and S-wave and P-wave groups in a seismogram are inverted with an aim to generate synthetics and compared with observed seismogram.

The focal mechanism solutions for P-wave polarity method showed the mostly dominant strike-slip and thrust type faulting in the source region. However focal mechanism solutions determined through waveform inversion for comparatively lower magnitude earthquake showed that most of the source are characterized by strike-slip type of faulting. In case of waveform inversion Computed Green's functions are convolved with mostly Hermann source-time function in spite of several attempt with other source time function. Hence source-path characteristics best utilize Hermann source-time function for the different earthquake source in the region to generate the proper synthetic seismogram. A good agreement between the observed and synthetic seismogram observed for best mechanism indicated that solutions are mostly reliable with reference to the velocity structure used. Moreover the study found that a low pass filtered seismogram is best suited for inversion rather than high frequency component. The close consistency of moment magnitude obtained from seismic moment with duration magnitude estimated from coda duration concludes a good agreement in the excitation energy associated with the amplitude of synthetic as well as

observed data. This study showed that seismograms recorded from a short epicentral distance could be modeled, provided the velocity structure is reasonably well known. The work was undertaken as a part of a Ph D programme.

Attenuation Parameters deduced from attenuation of Coda wave in NER

The selection of single scattering 2-D model $E \sim t^{-1}$ (where E is the energy present in the coda at lapse time t) instead of 3-D model $E \sim t^{-2}$ appear to be more apposite as the analysis of window length is more than 20 sec in which considerable energy is transferred into the mantle. The 2D model is better justified when it is assumed that almost all the energy going into the mantle is lost and does not scatter back to contribute to the coda. Gao et al. (1983) have calculated the effects of multiple scattering. Their results imply that when the single scattering assumption has been made, multiple scattering biases the Q estimate upwards, especially at greater lapse times (< 100 sec), thus contributing to the increase of coda Q with lapse time. The use of lapse time window length up to 90 sec (< 100 sec) makes multiple scattering insignificant.

Several authors (e.g. Aki, 1980; Pulli and Aki, 1981; Roeker et al., 1982; Vaneck, 1988; Akinci et al., 1994; Hellweg, 1995 and Gupta et al., 1998) have shown a strong co-relation between the degree of frequency dependence and level of tectonic activity for different tectonic regions. They ascertained higher "n" value for tectonically active regions compared to the stable regions. In this study it is observed that, increasing Q_0 with increasing lapse time. The attenuation parameters estimated varies from $Q_0 = 45.01 + 1.13$ and $n = 1.27 + 0.069$ at 20 sec to $Q_0 = 185.28 + 1.09$ and $n = 1.15 + 0.048$ at 90 sec for the AR group. For the SHL group the values are $Q_0 = 28.73 + 1.12$ and $n = 1.46 + 0.062$ at 20 sec lapse time window and $Q_0 = 114.34 + 1.06$ and $n = 1.19 + 0.036$ at 70 sec. Consequently for the IBR group of earthquakes the values are found to be $Q_0 = 23.87 + 1.06$; $n = 1.47 + 0.034$ at 20 sec and $Q_0 = 137.32 + 1.14$; $n = 1.25 + 0.056$ at 70 sec. It appeared that Q_0 values are not consistent for the region. The value of "n" is higher at lower lapse time.

Attenuation properties of sampled area

For a given region, Q_c represents an average property of the material of the volume that is sampled by the scattered waves. The Q_c estimates reflect the average attenuation properties of a volume covered by coda waves, which may be considered as an ellipsoid. In order to assess the media, the volume sampled by the seismic ray paths, ellipsoid shells, may be calculated on the basis of the lapse time used. For a given lapse time t, the scatter that are responsible for generation of coda waves lay on an ellipsoid. The longest event-station distance 217 km for the AR region, 228 km for the SHL and 270 km for the IBR region was considered to calculate the surface area projection. An S-wave velocity of 3.5 km/sec was considered to calculate ellipsoids for the three different event station distances 217, 228 and 270 km from TZR and lapse times 70, 80 and 90 sec for all the events in each of the tectonic blocks. For lapse time greater than 90 sec, the duration of the event ceases and in some cases the signal to noise ratio becomes extremely lower. As observed, for the AR group, the coda wave would sample a surface area of 21874 sq. km. inside a spherical shell. Likewise the coda wave would sample a surface area of 35742 sq. km and 40088 sq. km for the SHL and IBR group respectively. While estimating the radius of the sphere to be sampled by the coda wave, there was an overlapping volume among these three surface areas.

Qc Map

3890 Q_c values so calculated in each station for every earthquake event in the three tectonic blocks, were used for a spatial distribution map of the attenuation factor. Towards the preparation of this map a few values were interpolated through Krigging method. Ideally it was expected to have the stations and the epicenters distributed uniformly for better representation of spatial distribution Q_c values. In order to portray the spatial distribution map, Q_c values assigned to the mid-point of epicenter-station trajectories were considered. The contour plot correspond to 30 sec lapse time window at all the ten frequency bands. The plot indicated higher Q_c values in parts of AR and SHL blocks compared to the IBR block at 1-8 Hz. The Q_c plot indicated higher Q_c values in parts of AR and SHL blocks compared to the IBR block at 1-8 Hz. The Q_c values, on the other hand were found to be increasing for the IBR for 12-18 Hz. Western part of the AR near Bomdila, eastern part of the SHL and parts of upper Assam valley near Jorhat represented higher attenuation at all the frequencies. Mikir hills, Arunachal Himalaya and western part of Shillong plateau are characterized by lower attenuation, best outlined at 6Hz. The contour map (FIGURE 3) obtained corresponds to several high Q_c and low Q_c areas in this region. It is noted that the Q_c is lower in areas where the basement depth is deeper and higher where it is shallower.

Evaluation of an empirical relation between Network Duration Magnitude, MD(A) and Energy (E)

In connection with the derivation of an empirical relation between Network Duration Magnitude, MD (A) and Energy (E), initially, corresponding to ML estimates in the interval 2.5 - 6.0, the values of $\log_{10} E$ were calculated as per the Richter (1958) relation $\log_{10} E = 9.9 + 1.9 ML - 0.024 ML^2$. Next, following the relations Model I : $MD (A) = (0.92 \pm$

0.01) ML + (0.31± 0.04) ; Model - II : MD (A) = (0.94 ± 0.01) ML + (0.21 ± 0.04), the values of MD (A) were calculated corresponding to ML values. In order to derive the relation between MD (A) and Log10 E, the values of MD (A) and square of MD (A) were regressed against the estimates of Log10 E for ML during the interval 2.5 - 6.0. The relations obtained for both the models are : Model - I : $\text{Log}_{10} E = (9.23 \pm 0.02) + (2.01 \pm 0.01) \text{MD (A)} - (0.030 \pm 0.001) [\text{MD (A)}]^2$ and Model - II : $\text{Log}_{10} E = (9.48 \pm 0.02) + (2.03 \pm 0.008) \text{MD (A)} - (0.027 \pm 0.001) [\text{MD (A)}]^2$. These relations facilitated to obtain energies released during the earthquakes of duration magnitudes 2.5 - 6.0.

Modelling of Earthquake source and Ground motion in Chedrang Fault and its neighbourhood

The broadband data at different stations have different site noise characteristics. Variable pass bands were used for the station based on background noise evaluation. The noise and signal power spectra were determined using 60s long time series before and after the P wave first arrival. The low cut-off was then set at the frequency where the signal to noise ratio (S/N) was above 2.0. The high cut-off, on the other hand, was set at 0.05-0.08Hz to reduce the effect of scattering and to avoid the calculation of high frequency portion of the synthetics. The data is discarded if the bandwidth between two corners is too narrow (<0.03). An example for MND-Manikganj, East Garo Hills, Meghalaya contain a typical estimate of (a) frequency response to the ground velocity with known pole-zero distribution and (b) of the system noise power plotted as non-coherent power for vertical (Z=Red) and horizontal sensors (N=Green & E=Blue) upto 10 sec period band. The power spectral estimates were corrected for the system response and gain representing the sensor input. Station MND is instrumental in the Low Noise Model (Peterson, 1993), however due to increased cultural noise (0.1-1s, 1-10Hz) the highest power levels (Red, Green and Blue) were not significantly higher (<26%) than the low noise model (LNM). After 1s, 10 Hz the power level marginally (<10%) varied with LNM. The three lines approach the LNM indicating that the station minimum reflected actual ambient noise conditions across the whole spectrum. Pertaining to this study following results were obtained.

- The attenuation relations for Chedrang valley region through Coda Q.
- Evaluation of Crustal velocity structure for Chedrang valley and its vicinity
- Interpretation of the style of faulting and palaeoseismicity associated with the 1897 earthquake (paper published) .
- Determination of dominant period from velocity spectra for the region bounded by Latitude 24.80 - 26.60N, Longitude 89.80 - 91.80E , segregated in S-P difference of 1sec up to 15sec with an increment of 1sec interval.
- Present seismicity pattern of chedrang valley (July 2003 -February 2005) and characterization of earthquake source with its epicenter in chedrang fault and its vicinity through focal mechanism inversion and the orientation of pressure axis.
- Determination of Stress pattern in Chedrang valley through Stress tensor inversion (Gaphart's method).

Environmental Sciences

Remediation and management of coalmining waste land of North Eastern Coalfields of Margherita



In situ remediation of the environment degradation in overburden dumping site due to coalmine activity of the North Eastern Coal Fields of Margherita was undertaken. A site near NH37 was selected for in situ remediation study. Herbaceous plant species (*Axonopus compressus*), Monocot species *Eupetorium*, some wild bamboo species, essential oil bearing plants *Citronella* and *lemon grass*, Lianas *mimosa*, *Mugo*, *Dhanshya* and Tree species *Gomari* (*Gmelina arborea*), *Sisso* (*Delbergia sisso*) were screened to cultivate in coalmine overburden dumping site. Total soil quality improvement

viz. soil microbial activity, microbial biomass of the experimental plot was assessed before and after one year of treatment. It was found that the enzymes phosphatase, β -glucosidase, dehydrogenase and urease activity of the soil were enhanced. To compare the ecological parameters of the environmental degradation of the experimental plot, ecological data abundance, density and frequency were compared and it was found that the species dominance of the experimental site reached up to minimum threshold level of dominance. For improvement of plant growth and survival of the already screened overburden tolerant plant species, co-inoculation of PGPR strains was made. It was observed that the PGPR mediated plant growth and survival was enhanced. The population density and microbial biomass of the experimental plot were also enhanced. Soil physicochemical and biological properties were also evaluated. The development of microclimatic conditions for establishment of secondary succession, comparison of ecological data for abundance, density and frequency were continued. It was found that the species dominance of the introduced plants reached up to its maximum dominance level. Though a reduced canopy coverage was recorded in case of *Mimosa strigillosa* and *M. pigra* grown in coalmine overburden however, the canopy size reached to its minimum threshold size in comparison to the plants grown in un-mined soil. From the preliminary investigation, it was confirmed that *Mimosa strigillosa* and *M. pigra* are suitable species for mine overburden tailings secondary succession. The species of monocots Lemon grass (*Cymbopogon flesosus*) and Citronella (*Cymbopogon winterianus* Jowitt), the Eupetorium species and some bamboo species also reached its minimum canopy size. These species were also found to grow well in coalmine overburden dumps. However, for initial establishment amendment of organic manure seemed to be essential to get the targeted succession. Stunted growth and development were recorded in the plants introduced in the coalmine overburden dumping sites. The canopy size were also less than that of the actual size. Till date from the observations made it can be confirmed that a close cultivation of different plant species is urgently important to achieve the maximum dominance of different plant species. The cultivation of shrubby annual legume plant *Dhanshyas* leguminous plant which can fix nitrogen and shrubby leguminous plant species *Cassia*.

Assessment and promotion of wetland economic biodiversity of Manipur

The RRL sub-station at Manipur undertook a study of baseline information and analysis on the wetland bioresources, traditional medicinal plants, aromatic plants, wild edible plants, mushroom cultivation/culture and vermicomposting, etc. of Manipur. The work was funded by the GB Pant Institute of Himalayan Environment & Development of Almora.

Societal Activities

Propagation of *Lentinus edodes* - an exotic speciality mushroom in North East India



Lentinus edodes, commonly called Shiitake in Japan is the most important speciality mushroom for its medicinal and nutritional values. North Eastern Region of India is comprising of hills and plains with varied eco-climatic pockets which offer tremendous scope for large scale propagation of several species of Medicinal mushroom. Efforts were made to propagate *Lentinus edodes* Wood log substrate viz. *Quercus serreta* (Silkoak) are abundantly available in Manipur, Nagaland and Mizoram. The village people generally use this tree species for firewood only. After the introduction of Shiitake cultivation in this region, now the people of these village started cultivating this important medicinal mushroom on wood logs of *Quercus* species which could provide very good economic incentive to the rural mass. *Lentinus edodes* is a wood rotting saprophyte. The mycelium absorbs nutrient from the cambium part of the hard wood tree species of *Quercus serrata*. The tree log should contain the moisture content of 45-50% for its cultivation. If it is less than 20%, then the impregnation of Shiitake mushroom is checked. Again wood log with more than 60% moisture invites unwanted mould. Therefore, cut wood logs are kept as such in jungle for a period of 30-40 days which would help in maintaining proper moisture content for successful cultivation. With the objective of upliftment of socio-economic status of rural people, the laboratory provided technical support for propagation of Shiitake mushroom and its spawn development to the farmers of the region. During the period, extensive rural development

programme was carried out by way of imparting training, conducting awareness programmes and demonstration for scientific cultivation of Mushroom. SC/ST and weaker section of population totaling about 1800 people were benefited. The laboratory established two mushroom spawn laboratories in remote rural areas of Mizoram for easy availability of mushroom spawn in the region.

Socio-economic development of a village in Mizoram through aromatic plant cultivation

The aromatic plant cultivation was initiated in 50 ha. in a village near Aizawl, Mizoram in the presence of Minister of Agriculture, Govt. of Mizoram. The agro-technologies on aromatic plants like Citronella, Lemongrass, etc. as developed by the laboratory were transferred to the beneficiaries for cultivation in the designated areas with the help of some local NGOs. Cultivation of the aromatic plants and their processing helped in income generation and employment for the rural people of Mizoram which in turn directly or indirectly contributed to the national income. More than 300 beneficiaries were involved contributing towards organic farming by promotion of plant based industries in the state besides the income generation.

Training imparted to entrepreneurs for Shitake mushroom cultivation by Manipur sub-station

A two-day training programme on cultivation of Shitake mushroom was conducted at Senapati of Manipur state by RRL Substation organised jointly with Integrated Shitake Mushroom Producing and Processing Society during 24-25 August, 2005. The programme was jointly supported by the Forest Department of Manipur and the Deputy Commissioner of Senapati with financial grants. A total of 43 trainees comprising mostly of farmers including those from the states of Nagaland and Mizoram participated in the programme.

Efforts for propagation of mushroom cultivation in Arunachal Pradesh

Mother culture of *Pleurotus sajar caju* and *P. florida* varieties of edible mushroom were procured and 1748 packets of spawns were grown on local millet and paddy grain. 963 packets were distributed to 285 ST beneficiaries of Arunachal Pradesh for production and marketing of the produce. The beneficiaries of Arunachal Pradesh produced 750 kgs of edible mushroom and sold @ Rs. 80-100/kg. Altogether 10 training programmes with practical demonstration on cultivation of edible mushroom were organised in different places of Papumpore, Lower Subansiri, East Siang and Changlang districts of Arunachal Pradesh. Two women Self Help Groups, one NGO and three entrepreneurs were producing mushroom on commercial scale with the technical guidance of RRL Branch laboratory, Itanagar.

RRL Branch at Itanagar rendered S&T assistance for production of vermicompost and citronella cultivation in Arunachal Pradesh

The RRL Branch at Itanagar extended training and technical guidance to 15 farmers for production of vermicompost in different places of Arunachal Pradesh. 12 farmers of Papum Pare and Lower Dibong Valley districts were producing vermicompost for captive consumptions. Two entrepreneurs were producing vermicompost on commercial basis. A total of 101 ST beneficiaries were selected and they were trained on cultivation technology and supplied with 50,000 citronella slips and 65,000 rooted cuttings of Patchouli free of costs for growing citronella in the places like Hetlong, Tengmo of Changlang district and for Patchouli cultivation in the places like Rono, Emchi, Doimukh, Sonajuli, Taraso, Balijan, Karsingsha, Naharlagun, Kimin and Pachin of Papumpore districts and Pagba, Gangina, Pngchi, Hiya, Miba, Kambang, Peel village of the Kurung Kumey district of Arunachal Pradesh.

Two essential oil distillation units, one 600 kg/batch for citronella oil and other 500 kg/batch for patchouli oil were procured and installed at Jairampur and Sonajuli respectively which were handed over to the NGOs of the respective places for operation by utilizing the raw materials produced by the beneficiaries of the concerned villages and production of essential oils. Necessary training on processing technology imparted.

Empowerment of SC/ST and weaker section population in dominated areas of North East India through cultivation of non-traditional remunerative plantation

An area of 126 hectares of land was brought under the cultivation of Patchouli, Citronella, Lemongrass, Bamboo and Mushroom in Dimapur, Nagaland, BTAD, Nalbari of Assam and Lamphelat in Manipur. 136 beneficiaries were trained in cultivation and processing of aromatic plants and mushroom. Two distillation units of 500 kg/batch capacity were installed at 5th Mile Dimapur of Nagaland and Panitanki of BTAD, Nalbari for extraction of essential oil. Total production of essential oil and mushroom in these areas were 550 kg and 125 kg respectively.

Cultivation under Societal Programmes

Under Societal Mission, 130 hectares of land were brought under the cultivation of Patchouli, Java citronella, Lemongrass and Bamboo at different location of North Eastern states particularly in the states of Assam, Nagaland and Mizoram. Training was also imparted to 226 beneficiaries on cultivation technologies of medicinal, aromatic plants and mushroom.

Water Treatment design development and fixation of dosing for ONGC, Cinnamara Colony

Water treatment plant at ONGC, Cinnamara Colony was inspected by RRL team for optimizing the water quality of the water treatment plant at their residential cum office complex. Operational parameter of the treatment plant which has a capacity of 4.5 lakh litre per day was investigated and remedial measures suggested for improving the quality of drinking water. Similar investigation was carried out for a second water treatment plant of capacity 1 lakh litre in the AB-Type complex of the ONGC Colony. Partial implementation of RRL's recommendations improved the treated water quality of the plant and the iron content of the water came down from 3.5 ppm in the raw water to about 0.69 ppm in

the treated water. Further implementation of the recommendations were in progress and it was expected this would greatly benefit the residents of ONGC Colony who are dependent on the water supply from the treatment plant.

PROGRESS OF NETWORK PROJECTS

Project Code: CMM-0004

Name of the project :

Designing Plants and Animals as Bioreactors for Proteins and other Products. (CMM-0004)

Major Objectives :

Scale up and development of downstream processing technology for production of Ginsenosides from Ginseng cell culture.

Significant scientific Achievements in terms of deliverables and outcome :

Under a CSIR network programme, technology development work on production of Ginsenoside, a terpenoid saponin and versatile multi-purpose drug, through plant cell culture using a developed cell line of *Panax quinquefolium* is under progress in collaboration with CIMAP, Lucknow. The research will lead to development of technology with design of bioreactors and down stream processing techniques for achieving improved techno-economic benefit for production of Ginsenoside through plant cell culture in bioreactors for commercial exploitation. An improved and stabilized cell line has been brought from CIMAP and cell cultures in different bioreactors have been conducted with sub-cultured material for optimizing the culture and reactor conditions to harvest the yield. Down stream processing techniques have also been developed for separation and purification of the product. The Ginsenoside isolated and purified from the bioreactor harvests have been analytically examined for the presence of Ginsenosides by TLC/ HPLC and compared with that of the authentic crude extract from Sigma Aldrich American Ginseng powder and have shown similarity.



Project Code : CMM-0005

The Project :

Development of Catalysis and Catalysts :

(Activity for RRL, Jorhat) : Friedel-Crafts Alkylation to produce Raspberry ketone and others using layered clay based solid acid catalyst (CMM 0005.3.1)

Major Objectives :

(a) To prepare metal(cation) - metal salt - Clay (Montmorillonite) composites useful as solid acid catalysts particularly for Friedel Crafts Alkylation reactions of phenol with 4-Hydroxybutan-2-one(gKB) to produce 4 (4'-hydroxyphenyl) butan-2-one (Raspberry ketone).

(b) To scale-up suitable catalytic processes for generating data for technology package.

Significant Achievements

Industrially important organic molecule such as 4-(4'-hydroxyphenyl)butan-2-one also known as "Raspberry Ketone" is used in perfume industries, food industries and also in compositions for weight loss with improved taste. Raspberry ketone are produced by alkylation of phenol with vinyl ketone or 4-hydroxybutan-2-one in presence of hazardous acid

catalysts, such as H₂SO₄ and HCl or cation exchange resin or by biocatalyst oxidation. Different Mn⁺ - Mont were reported as catalysts for alkylation of phenol with 4-hydroxybutan-2-one to produce the compound with limited efficiency. There are also reports of use different types of modified zeolite, H-beta zeolites and other solid catalysts, but the process could not show high efficiency.

A process has been developed by RRL Jorhat to produce 4-(4-Hydroxyphenyl) butan-2-one using modified supported clay(Montmorillonite) as solid acid catalysts where about 80 % selectivity and 40% conversion were achieved. The surface area (BET), oxidic compositions, thermal characteristics, crystallinity (XRD) etc. of the catalysts were determined. The reaction products were characterized by GC, NMR, IR, HPLC and elemental analyses.

Project Code : CMM-0006

The Project :

Developing green technologies for organic chemicals - bioactive molecules from medicinally important natural products.

Objective :

(a) To cleave the side chain of phytosterols, cholesterol, sitosterol and stigmasterol by microbial and chemical methods.

Significant Achievements

(a) Collection of soil samples from various parts of Assam especially hydrocarbon contaminating areas.

(b) Selective isolation of microbial strain.

(c) Screening of microbial strains of transformation of phytosterols.

(d) Studies on the oxidation of side chain of phytosterols for preparation 16-DPA by green chemistry methods.

(e) Isolation and identification of major products from biotransformation.

(f) A fresh proposal was submitted as per direction of the Monitoring Committee and presented to Chairman Task Force of CMM-0006. Approval awaited.

Project Code: CMM-0012

The Project :

Coal characterization and Resource Quality assessment for specific end uses

Objectives :

(i) Quality assessment of the coals of NE region in general, Nagaland and Arunachal Pradesh in particular with relevance to utilization potential in domestic and industrial sectors.

(ii) Chemical characterization and assessment of trace and heavy metals in coals of N E region.

(iii) Removal of sulphur and mineral matter including trace and heavy metals.

(iv) Utilization potential of the processed coals, recovery of chemicals, etc.

(v) To optimize the process parameters at laboratory scale for demineralization of N E coal using chemical additive/dispersant, Scale up and to identify alternative chemical reagent/process.

Significant Achievements :

- (a) Carbonization of caking NE coals in modified non-recovery ovens yielded cokes, found suitable for cement making by VSK technique and the coking period was reduced with increase in yield. Sulphur mapping of NE coals and distribution during high temperature carbonization was established.
- (b) Additive carbonization for non-caking coals showed higher retention of sulphur in coke/char.
- (c) Washability studies of Assam coals showed that maximum recovery of coal (82-91%) along with demineralization.
- (d) Workshop cum Interactive Meet on Characterization and gainful Utilization of N E coals organized at Guwahati with the entrepreneurs/end users, Govt. agencies, coal producers and R&D institutes, where about 100 participants from various organizations participated in the deliberations. In the workshop, the sustainable technologies adaptable for N E coals, CSIR technologies suitable for N E coals and RRL Jorhat processes/ technologies evolved for N E coals were presented.
- (e) A book was released in the workshop containing general characteristics of N E coal (a database till date analysis), Coal carbonization with special reference to N E coals, Genesis of sulphur in N E coals, desulphurization of N E coals, mineral matter contents of N E coals and environmental issues like industrial waste minimization and bio-chemical clean up related to mining activities.

Project Code : CMM-0019

The project:

New Building construction Materials and technology for Sustainable Development

Objectives :

- (i) The primary objective of the project is to utilize agro-industrial waste along with polymeric waste for production of wood substitute products useful as building construction materials.
- (ii) Survey of quantum and areas of availability of agro and agro-industrial wastes and polymeric wastes suitable for this project.
- (iii) Evaluation of the characteristics of agro and agro-industrial wastes and study of their suitability for the products aimed at.
- (iv) Evaluation of the characteristics of various polymeric wastes and study of their suitability for the products aimed at.
- (v) Pollution abatement.

Significant Achievements

- (a) An appropriate technology for the manufacture of doors and window frames/panel products by utilizing polymeric and agro-waste.
- (b) Papers and patents from the R&D studies.

Project Code : CMM-0024

The Project :

National Standards of Measurement & Apex calibration facilities and creation of high quality Network of Testing and Calibration laboratory

Objectives :

- (i) Establishment and up-gradation of Calibration/ Testing facilities for Electrical, Pressure, Temperature parameters and to provide Calibration/Testing facilities traceable to National Standard as per International Standard.
- (ii) To cater to the need of Testing and Calibration facilities for different organizations/firms of N E region.

Significant Achievements

- (a) Installation of the main Calibration Unit (Multi- product Calibrator 5520A) was completed.
- (b) Preliminary works on Testing and Calibration was started on the Laboratory's equipments with good results.
- (c) Communications were made with various Agencies/ Organizations of NE region for their requirements and contracts.



Project Code : COR-0004

The Project :

Development of Novel Polymeric Materials : Sub Project - Speciality Polymers for Petroleum Industry

Objectives :

- (i) To develop polyolefin and polyacrylate based additives that perform as pour Point depressants, flow improvers, viscosity index improvers, drag reducing agents, corrosion inhibitors and dispersants for petroleum based oils.
- (ii) To establish relationship between the structures (including microstructure) of these molecules and their properties performance.
- (iii) To evaluate the performance of the polymeric additives for lube oil, diesel oil and crude oil.

Significant Achievements

- (a) Development of additive formulations/methodologies for transportation of heavy and high waxy crude oils
- (b) Improved synthetic solventless methods for synthesis of (meth)acrylate based additives.

Project Code : COR-0008

The Project :

Industrial waste minimization and cleanup - bioremediation /phytoremediation. Remediation and management of coalmining waste land of Northeastern Coalfields, Margherita.

Objectives :

- (i) Literature survey, site selection and collection of soil sample and creation of in-house facility for the experiment.
 - Evaluation of soil characteristics, phytotoxic characterization and assessment of Environmental degradation.
 - Survey of locally grown cultivation and screening of local pollutant tolerant plant species and its management practices.
- (ii) Evaluation of threshold limits of the pollutants absorbed by the different plant parts

- Feasibility study of co-inoculation of PGPR strain to reduce the pollutants phytotoxicity under green house condition.
- Preparation of different formulation to improve the soil quality and its effect on soil reclamation and for sustainable development.
- Screening of various seasonal and timber yielding plants for the remediation. Biochemical analysis of the pollutants effects on plants along with the soil quality improvement.

(iii) - Field trials and repetition of the experiment and biochemical analysis.

(iv) - Repetation of the experiment cited in the Phase I & II

- Final observation of the protocol developed for remediation, preparation of final report and transfer of technology developed for sustainable development of the coal mining remediation.

Significant Achievements

(a) Developed methodology for creation of microclimatic conditions to achieve climax state of succession.

(b) Developed protocol to screen different plant species to grow in adverse environmental condition.

(c) Developed methodology to generate microbial inoculum for root inoculation to decrease the coalmine pollutants phytotoxicity.

Project Code: COR-0023

The Project :

Development and Commercialization of Bioactive and Traditional preparation

Objective :

(a) Development of plant based drugs/insect control agents

Significant Achievements :

(i) More than 1500 extracts and lead extractives were taken up for agro-bio-evaluation against designated target insects under Toxicity, Feeding deterency and IGR studies. 6 extracts were confirmed to have promising activities by repeat screening.

(ii) 89 plant sample were collected. Among these, 51 herbarium specimens sent to NBRI , Lucknow, seed samples of 39 sps. Sent to CIMAP and 89 plant samples to RRL-Jammu.

(iii) A total of 16 number of plants and 16 number of plant parts were extracted with three different solvents and a total of 47 number of extracts made. These extracts were sent to different bievaluating laboratories for screen against different diseases. Out of the extracts sent earlier a total of 3 number of extracts have shown promising bioactivity and accordingly 2 number of repeat samples were sent off for confirmation of the bioactivity. Two samples bearing codes RJO342P01A001 and RJO1923P13A001 exhibited strong antimalarial activity in vitro. Under single molecule discovery scheme a total of 9 pure single molecules were sent for bioevaluation. Out of these samples RRLJ-Dan/Eto exhibited anti-gastric ulcer activity and sample RRLJ-Dan/Ac exhibited anti-Parkinson's activity.

Project Code : SMM-0002

The Project :

Exploration and exploitation of microbial wealth of India for novel metabolites and biotransformation processes.

Objectives :

- (a) Collection of samples such as soil, water, bark of trees from N E Indo-Burma region.
- (b) Isolation of 200 microbial strains per year from various ecological niches of Indo-Burma hot zone and their maintenance.
- (c) Characterization and maintenance of culture
- (d) Biotransformation of : Nicotinic acid, Stevaladil, LND623 and Funtumidine.
- (e) To dispatch 200 strains per year in NCL Pune for biotransformation.

Significant Achievements

- (i) More than 75 samples of soil, water, sand, mud from hot-spring, cold spring and plant bark, litters were collected from various ecological niches prevalent in Indo-Burma hot zone. Altogether 590 strains were isolated and maintained in pure culture state for short-listing to dispatch to NCL, Pune. Strains were screened for lipase activity and few strains were selected for biotransformation.
- (ii) 90 strains (Bacteria 59 & Fungi 31) were dispatched to NCL Pune in January, 2006.
- (iii) Laboratory scale technology for biotransformation of Nicotinic acid to 6-hydroxy-nicotinic acid were transferred to M/s Jubilant Organosis, Noida.
- (iv) Reactions for standardization of 16-DPA viz. 20-hydroxy-3a-amino-5a -Pregnane was completed upto 5th step.
- (v) Fresh samples were collected from Loktok lake of Manipur for isolation of new batch of strains with new functionality.
- (vi) Also isolated 7 endophytic fungi & actinomycetes from medicinal plants of Tawang, Bomdila, Arunachal Pradesh (altitude 12,000 ft.), endowed with promising antimicrobial activity. As part of the collaborative work with IMTECH, Chandigarh, 2 Nos. of endophytic fungi were sent to IMTECH for sequencing and identification.

Project Code: SMM-0005

The Project :

Pollution monitoring & mitigation systems & devices - assessment & management of environmental degradation in and around the coal mines of North Eastern Region.

Acid Mine Drainage from North Eastern Coalfields, its assessment and management.

Objectives :

- (a) Identification of the AMD affected areas in the coalmines of Assam and Margherita.
- (b) Chemical characterization of mine tailings, affected soil, sediments, water with Seasonal variations.
- (c) Genesis of AMD and speciation of toxic metals in the environment.
- (d) Development of site-specific monitoring systems, methodologies/systems for mitigation, environmental awareness & EMP.

Significant Achievements

- (a) A State-of-Art Report was prepared containing history of coal



mining in NE region, Environmental aspects, acid mine drainage, status of research, International and national status work carried out at RRL-Jorhat, management options, end users, literature survey, etc. were prepared.

(b) Survey & identification of strategic mines/sites affected by coal mining activities particularly with respect to formation and effect of Acid Mine Drainage (AMD) in Assam was done. Simulation studies in the laboratory and characterization of Samples were conducted for prediction of acid-generating potential, acid-base accounting for coal and mine reject samples were done by Static and Dynamic leaching methods which resembled the characteristics of the samples collected from mine sites. The test is a water quality predictor. Mobility of toxic metals during leaching was also studied. Studies of neutralization potential, survey of cheap raw materials for neutralization, comparison of simulated data with site samples was done for Makum coalfields, trace and heavy metals in coals, OB materials and AMD water, its mobility to the environment were evaluated.



(c) Genesis of AMD in some of the NECL coal mines in Assam was established. Reaction kinetics for oxidation of pyrites in some coal samples was established.

(d) Remediation technique for inhibition of pyrite oxidation in coal and mine rejects was developed for NECL coal mines. A management technique for treatment of acidic effluents from simulation of weathered coals from NECL mines was developed and pilot plant trials were conducted which proved that the process could be transferred to the actual affected sites.

(e) The characterization of the simulated aqueous leachates resembles the characteristics of the samples collected from mine sites of Jaintia hills, Meghalaya.

(f) Trace and heavy metals in coals and OB/reject materials from NECL and Meghalaya were evaluated by EDXRF.

NMITLI Project :

The Project :

Genetic improvement of *Jatropha curcas* for adaptability and soil Yield

Objectives :

(a) The project envisages selection and improvement of *Jatropha curcas* germplasm for higher survival and adaptability to drought and wide range of soil conditions, high seed yield and optimization of low-cost agrotechnologies for different agroclimatic regions.

Significant Achievements :

(i) Accessions of *Jatropha curcas* were collected from different states of North Eastern region and planted in the poly bags as well as in field. Seeds of *J. curcas* were also collected for fatty oil extraction and maximum oil recovery was found in some promising accessions.

R & D SUPPORT ACTIVITIES

Information & Business Development

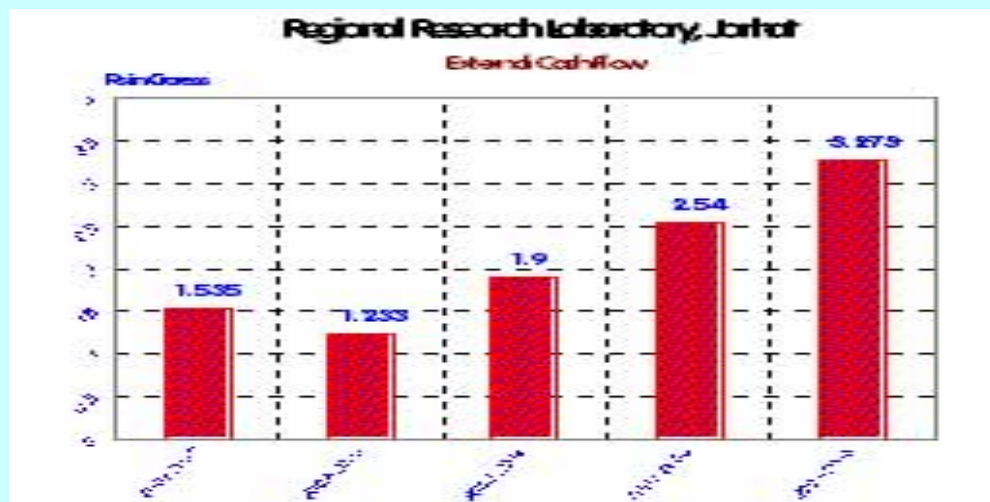
Having served as a window of the laboratory to the outside world on the one hand and coordinating the overall business development activities of the laboratory on the other hand, the Information & Business Development Division continued to discharge the dual responsibility of maintaining liaison activities with the industrial houses, entrepreneurs, govt. departments, private and public sector industries, etc. as well as outsourcing the laboratory's expertise and capabilities for economic and societal benefits of clients, customers and users. The division tried to consolidate the gains of research and development of the laboratory for helping the entrepreneurs and users who were in need of RRL's assistance in their desired form.

Publications

The division brought out the laboratory's regular publications such as Annual Report and 6 issues of RRL Jorhat News which are the mouth pieces of the laboratory. Apart from this, the division also brought out the occasional brochures like -

- (i) Annual Report
- (i) RRL News Letter
- (iii) RRL-Jorhat Technologies
- (iv) CSIR Annual Report (RRL Jorhat Chapter)
- (v) CSIR News (RRL Jorhat Chapter)
- (vi) Highlights 2005-2006
- (vii) Impact of RRL Jorhat (Updated version)
- (viii) Vision
- (xi) Rural Development Activities Report
- (x) Advertisements in souvenirs

The division also prepared a number of write-ups on the various activities of RRL-Jorhat as were required by various institutions for insertion in their publications. In its effort to give wide publicity of the laboratory's technologies, expertise, knowledgebases, etc. and with a view to gearing up the business strategies of the laboratory, the division issued various press releases on the important events and achievements of the laboratory from time to time, sent materials to Head quarters for publication in the CSIR Annual Report and CSIR News, released advertisements in various souvenirs and journals, publishing special articles and reports, etc. in the local and regional dailies, contributing to audio-visual media like Doordarshan, All India Radio and local TV news channels. The division sent materials of RRL Rural Development Activities for making presentation to Hon'ble Minister of Science & Technology and Vice President of CSIR.



MoU signed

The division was instrumental in the transfer of RRL technology on Low Dust Chalk Pencil to three entrepreneurs from within the state and arranged signing of Memorandum of Understanding with the following parties namely

- (i) with Allahabad Agricultural Institute - a Deemed University for establishing close linkages and functional coordination between AAI -DU and RRL-Jorhat on 19 April, 2005
- (ii) with Assam Medical College, Dibrugarh for establishing close linkages and functional coordination between AMC, Dib. and RRL-Jt. on 23 March, 2005
- (iii) with POGL, Guwahati for utilising infrastructure, laboratory and HRD facilities of RRL for human resource development in the energy sector for mutual benefit on 18 January, 2006 and

Interactive Meeting with Industry

The laboratory organised Interactive meeting with Federation of Industries & Commerce of North Eastern Region (FINER), Guwahati for taking initiative to exchange outcomes of research and development and economic information and possibilities that may be available from either or both to disseminate to the industrialists and entrepreneurs on 6 August, 2006.

Patent

The division handled the IPR matters of the laboratory and extended IPR services to the scientists as well as outside parties in matters of filing and obtaining of patents. During the year a total of 12 Indian patents were filed and got as many as 13 Indian patent granted. Efforts were continued to get foreign patent filed and granted.

Technology commercialised

Low Dust Chalk Pencil to

(i) Shri Abonti Kr. Dutta, Panchavati, Charigaon, PO : Bahona, Jorhat and

(ii) Ms Papori Pujari, Kanchan Nagar, Borbheta, Jorhat - 785005.

The division responded to numerous queries relating to technology transfer and R&D of the laboratory and took care of more than 5000 visitors comprising of students, teachers, VIPs, industrialists, entrepreneurs, etc and continued to maintain records and process the testing, analytical and technical services rendered by the laboratory to outside parties, projects undertaken and completed, etc. During the year the division processed 15 new research project proposals for sending to respective funding agencies. contracted 11 Grants-in-Aid project worth Rs 255.071 lakh, 1 Collaborative Research Project worth Rs 9.83 lakh and 7 Consultancy projects worth Rs 59.21 lakh. The laboratory earned Rs 8.1 lakh as testing and analytical charges. As usual the division was responsible for conducting the Customer Satisfaction Evaluation of the various services rendered by the laboratory to its clients in close coordination with CSIR.

Right to Information

The division prepared the details of information pertaining to Right to Information Act and put up in RRL Websites viz. www.rrljorhat.res.in and www.rrljorhat.com. In this regard Dr P C Tamuly, Public Relation Officer and Dr L Nath, Assistant Public Relation Officer of the laboratory were nominated by the Competent Authority of RRL Jorhat.

Customers Satisfaction Evaluation

The division continued to look after the Customer Satisfaction Evaluation of the various completed lab-projects. During the year, 4 nos. of completed consultancy projects, rendered to industries, were sent for evaluation by the Customer Satisfaction Evaluation Unit of CSIR at Pune and the satisfaction level of all these projects as reported back to RRL by the CSEU after obtaining the feed backs from the concerned customers, was very good securing 4 points each in the 5-point scale.

Celebration and Exhibitions organised

The division was responsible for participating and organising various meetings and exhibitions of the laboratory.

The division organised National Technology Day on May 11, 2005, CSIR Foundation Day on 26 September, 2005 and National Science Day on 28 February, 2006 and organised and participated in the following industrial and S&T exhibitions :

(1) The North Eastern Agricultural Fair/Exhibition held at Assam Agricultural University, Jorhat during 2-4 March, 2005 organised by AAU-Jorhat.

(2) Technology Exhibition on 'Appropriate Technology for Development' organised by State Council of Science, Technology & Environment of Meghalaya held at Shillong during 9-11 March, 2005

(3) Science Exhibition of the Sankardev Vidya Niketan and placed the Mobile Exhibition Van displaying RRL technological exhibits on 24 April, 2005.

(4) Science & Technology Exhibition organized by RRL Jorhat at Gyalsing and Bermiok, Sikkim on the occasion of YRY 2005 celebration during 17-18 April, 2005

(5) S&T exhibition named as NICT 2005, the first ever ICT exposition in the Northeast organised jointly by Business World, Nasscom and The Telegraph at Guwahati during 1-2 September, 2005. The theme of the event was Enabling the North East and the objective of the event was to provide the Indian IT industry a networking opportunity with key policy matters, financial institutions, key industrial contributors and players with the IT enthusiasts in the region and create opportunities for beneficial dialogue and to showcase the goods and services available in the North East to give an efficient and effective market linkage and make the budding entrepreneurs of the region aware of the emerging technology and skills available.

(6) Industrial Exhibition named as 'Enterprise North East 2005' organised by the Assam State Office, Confederation of Indian Industries (CII) at Guwahati during September 6-10, 2005.

(7) Science exhibition name as Maha Bhaskara Shastra Pradarshini organised by the Vivekananda Kendra Shiksha



Prasar Vibhag, Laipuli, Tinsukia during October 2-4, 2005. The exhibition was inaugurated by Sri KK Choudhury, Regional Officer, Central Board of Secondary Education, Guwahati.

(8) Pharmaceutical Expo 2005 organised by Federation of Indian Chambers of Commerce & Industry (FICCI), New Delhi with the concurrence of 57th Indian Pharmaceutical Congress held at HI TEC City, Hyderabad during December 2-4, 2005 which showcased the RRL technologies on drugs and healthcare products.

(9) Exhibition organised in connection with the celebration of 4th Assam Mahotsava-2005 by INTENDEM held at Jorhat Court Field during 16-28 December, 2005.

(10) AEC World Expo & Conference held at MMRDA ground, Bandra Kurla Complex, Mumbai during 15-18 December, 2005. About 120 national and international exhibitors took part in the Expo. Sri A Biswas and Sri D C Saikia, TO(EI) were deputed for the same.

(11) Participated in the Tripura State Science Fair-2006 jointly organised by the Tripura State Council for Science & Technology, Govt. of Tripura and the State Council of Educational Research & Training, Tripura held at Children's Park, Agartala during 5-10 January, 2006.

(12) Participated in the `Exhibition-cum-Fair on Rural Technologies' held at Amethi, Uttar Pradesh during 18-22 February, 2006 and displayed its exhibits in the `CSIR Showcase' as per the directives of the CSIR,USD, New Delhi.

Planning

The Planning Division prepared the Annual Plan 2006-07 and project budgets under the Tenth Five-Year Plan (2002-07), highlighting the major R&D achievements. The manpower deployment in inhouse, grant-in-aid, sponsored and consultancy projects were analyzed and reviewed by the division and the resource use efficiency was examined. Resource requirements and its utilization were reviewed in various stages and corrective measures were taken for better R&D management. The division also prepared another report on CSIR Network projects taken up by the laboratory for the Tenth Five-Year Plan. The formulation of Supra Institutional Project of the laboratory was initiated. Various audit queries



on the working of RRL-Jorhat from the Comptroller and Auditor General of India (CAG) were replied to.

In the extramural human resource development activities, the division organized two five-day motivational programmes for



talented students and teachers of High/H.S. Schools from different parts of Assam, Tripura and Sikkim States. The programme generated a lot of enthusiasm among the participants and they were highly benefited. The programmes were sponsored by RVPSP, DST, New Delhi. The final report on the Motivational Programmes programmes were sponsored by RVPSP, DST, New Delhi. The final report on the Motivational Programmes was sent to sponsors. Three project proposals had been submitted to RVPSP, DST, New Delhi, Ministry of Human Resource Development, GoI and the Ministry of Environment and Forests, New Delhi, for financial grant.

Interactions with R&D and S&T support divisions/sections were maintained and various support on R&D activities and other inputs was given from time to time. During the year, various information on R&D progress, manpower utilization, financial allocations and other database information were supplied to CSIR Hqs and other organizations. Database on manpower, project budget, and statistical profile of the laboratory were utilized for efficient R&D planning. Monthly and quarterly progress reports on R&D programmes had been scrutinized and sent to CSIR Hqs.

The division coordinated the celebration of the CSIR Foundation Day on 26 September 2005 and organized an essay

competition on science topics among the wards of RRL staff. Certificates and prizes were distributed to the winners on the Foundation Day.

Library & Documentation

The Library & Documentation of the laboratory is considered as one of the largest special Research library of the North East India. It is a service-oriented division continued to provide library and information services to R&D staff, Research Fellows, outside students and individuals, universities of N E Region and other R&D and industrial institutions such as Institute of Biotechnology and Geotechniques Studies, ONGC Jorhat, Central Muga & Eri Research & Training Institute, Jorhat, ONGC Complex, Cinnamara, Jorhat, Central Muga & Eri Research & Training Institute, Lahdoigarh, Jorhat, etc. The library provided services to the RRL Branch Laboratory also. During the period library could add 254 books and 130 IS specifications to its stock. The library subscribed 79 foreign and 86 Indian journals. As a Document Delivery Service, the library received 47 Indian and foreign papers published elsewhere from NI SCAIR, New Delhi, other information centers on advance payment and supplied 126 articles to several universities, information centers and R&D organizations on request. It also collected 748 Annual and other reports from various R&D and academic institutions.

The CAS and SDI services were provided to the users regularly, besides bringing out 'Current Abstracts', 'Current Topics' and News Index regularly during the period. Literature survey and searching were done for different topics of various disciplines as and when required by the scientists and made available to them. The library brought out following bibliographies -

(i) "An Annotated Bibliography on Ethnobotany of North Eastern Region"

(ii) Abstracts on Dammaranes.

The library was maintaining the database on publications and presentation of papers from the laboratory on the basis of which various reports with bibliometric analysis of laboratory's publications were carried out from time to time as and when required by the management. A database on theses of RRL, Jorhat was prepared and updated through adding the new additions. Database on 'Current Information' collected from journals received in the library was updated using CDS/ISIS for publication of 'Current Contents'. Database on 'Lib Sci' collected from the library and information science journals received in the library was being up-dated using CDS/ISIS for publication. Reference services were done as and when needed by the regular users and also the outside users.

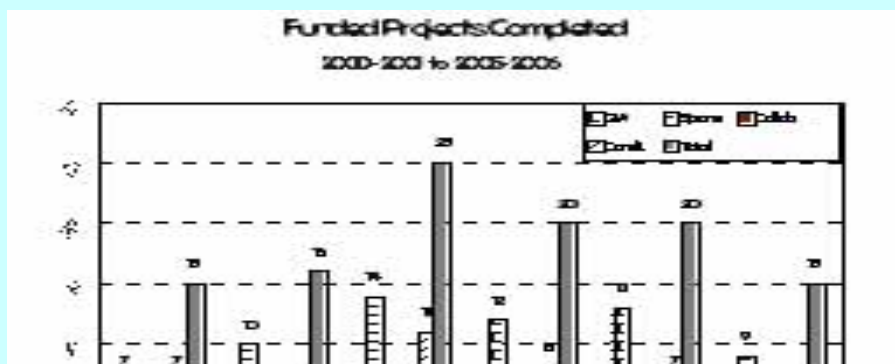
The reprography section of the library copied 1,06,451 pages of documents during the period and earned an amount of Rs 5348 .00. The library earned Rs. 11,570.00 as membership fee from outside institutions, individuals and students during the period . Under the modernization plan, the library was linked with outside world in general and CSIR in particular through Internet facility. Computer terminals were provided to the users for their accessing and searching purposes in E-mail and internet facilities.

A book exhibition, exhibited by N E Allied, Jorhat was organized in the library during 10 -11 August, 2005 for the benefit of the scientific community.

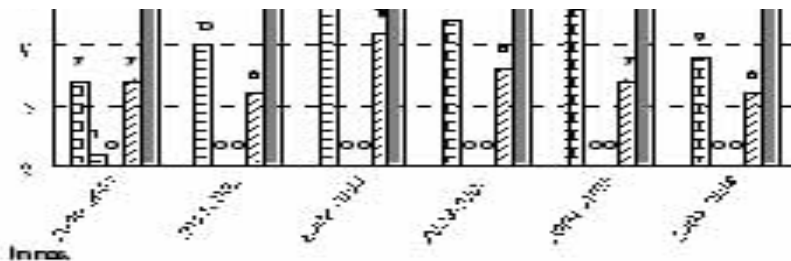
Planning, Monitoring & Evaluation

The PME Cell was involved in the monitoring of the externally funded as well as CSIR Network & Task Force projects. The cell maintained databases on the financial, technical and manpower deployment aspects of the projects, Project Folders of all externally funded projects as well as CSIR Network and Task Force projects. The cell prepared the ECF commitments of various R&D divisions for the reporting year and the total ECF commitment of the laboratory thus prepared was communicated to CSIR Head quarters. The total ECF of the laboratory during the reporting year amounted to Rs 322.00 lakhs which comprised of the receipts from Govt. Deptts/Ministries, Public Sector Industries and Private Sector Organisations to the extent of 87.24%, 10.19% and 2.57% respectively. The commercial Rupee value of ECF generated was found to be Rs. 41.08 lakhs being 12.76% of the total ECF.

During the year 19 new projects were contracted, out of which 7 were consultancies, 11 Grants-in-Aid and 1 Collaborative project. In consultancy projects an amount of Rs. 15.24 lakhs was realized from existing projects and Rs. 29.25 lakh from newly contracted projects leading to a total of Rs. 44.49 lakh. In Granti-in-Aid projects an amount of Rs. 87.71 lakh was realized from existing



projects and Rs. 172.26 lakh from newly contracted projects leading to a total of Rs. 259.97 lakh. In Collaborative project an amount of Rs. 9.83 lakh was realized from a new project. Rs. 7.56 lakh was received as technical services charges including testing, analysis and miscellaneous. Rs. 0.13 lakh was received as premia.



The Cell attended to audit parties in matters of receipt and expenditure aspects of externally funded projects and coordinated the job of working out the service tax due and accrued from the various services rendered by the laboratory during the year. The Total Service Tax realised from the various services was worked out to be Rs. 5.32 lakh.

The Cell reviewed and updated the Organisational Chart of the laboratory vis-a-vis the existing staff strength, programmes, resources and facilities available. The Cell compiled the data on the funded projects as required for (a) the Institute of Advanced Study in Science and Technology (IASST) Project - "Database of R&D institutions by Broad Research Areas in North Eastern Region", (b) Indian Institute of Management (IIM), Calcutta for Project on the Nature of Innovation Process, (c) R&D project funded by Oil Industry Development Board (OIDB), Ministry of Petroleum and (d) Projects related to development and benefit to Scheduled Tribe Population as required by Ministry of Tribal Affairs.

Human Resource Development Cell

Human Resource Development Cell of RRL-Jorhat rendered a wide range of activities of human resources of the laboratory as well as extramural human resources towards R&D management of the laboratory. The cell arranged for engagement of 39 Project Assistants (PA) to assist in the research activities of different externally funded projects of the laboratory. Deployment of Woman Scientist (WS), Research Associate (RA), Senior Research Fellow (SRF) and Junior Research Fellow (JRF) was done under fellowship programmes sponsored by DST and CSIR for research activities. Thus 2 WS, 1 RA, 2 SRFs and 2 JRFs were deployed in different divisions of the laboratory during the year. In addition to these, 5 Guest workers were also engaged in different divisions to carry out research works leading to Ph D. With the new deployment, the total strength of Research Workers during the year 2005-2006 stood as follows :

Research Workers :

Women Scientist	03	Jr Research Fellow (P)	04
Research Associate	03	Project Assistant	57
Research Associate (P)	01	Guest Worker	12
Sr Research Fellow	09	Teacher Fellow	02
Jr Research Fellow	05		

The cell made arrangements for reviewing and monitoring of the progress of work of Research Workers for extension of fellowship. During the year 2 Scientists were deputed abroad for participation in an international workshops and for presentation of research paper. Nomination of scientists for national awards and fellowships was sent to different agencies.

CSIR Scheme of Cash Award to bright SC/ ST students

Under the CSIR scheme of cash award to bright SC/ ST students, 15 bright students belonging to SC/ST community and who have passed Class X examination from State Boards were selected from different states of North Eastern Region. They were awarded cash prizes with certificates at a function held on 26th Sept, 2005. The objective of the scheme is to motivate bright SC/ST students to take-up science studies at +2 Junior College level.

CSIR Programme on Youth for Leadership in Science(CPYLS)

For implementation of CSIR programme on Youth for Leadership in Science (CPYLS), the cell organized 2days programme on November 9-10, 2005 at the laboratory for the bright students who have passed class X examination from different boards of North Eastern States. 45 students and their escorts participated in the programme. The objectives of the scheme are to expose the young minds to the exciting world of science, to help in building up a scientific temper at an early age and instill a sense of pride in the achievements of Indian science also to encourage

the students to pursue science studies in future.

Apprentice Training Programme under Govt of India scheme

Graduate and Diploma holder engineering students were imparted practical training for a period of one year in different engineering disciplines under a Govt of India scheme. During the year 3 students participated in the programme. Under trade Apprentice Training programme HSSLC/Graduate(Science) and I TI passed candidates were imparted training in different trades like laboratory assistant, draughtsman, electrician, welder, fitter, electronic mechanic, plumbers etc. The duration of the training programme is one to three years according to the trades. During the year 23 candidates were engaged for the training. Based on the requirement of different universities, colleges and other institutions summer training, industrial training, practical training were imparted to a large number of students of different academic institutions of the country. The duration of the programme ranges from one month to six months.

The Cell was closely associated with different activities of Research Council (RC) of the laboratory. RC agenda and other reports were prepared and follow up activities were carried out.

Under Management Information System (MI S) a database on Apprentice Trainees from the year 1979-1980 to 2005-2006 was created and prepared a report. Existing databases, viz., foreign visit of scientists, research workers, training undertaken, Ph D awardees, manpower of the laboratory were updated and necessary reports were prepared for effective management. The Cell was associated in the process of HRD activities being taken up by POGL, Guwahati at this laboratory. The cell assisted the management in assessment and recruitment processes of S&T members of staff. It also continued to assist the Director in the S&T activities. The cell assisted the management in management of Boys' and Girls' hostels and the Guest house of the laboratory.

Ph D awarded

1. **Dr Nandini Kumari**, Research Worker of the Material Science division was awarded the Ph D Degree for her thesis titled 'Synthesis and characterization of carbonyl complexes of rhodium and ruthenium containing different types of donor ligands and their reactivity' by the Dibrugarh University. She worked under the guidance of Dr DK Dutta, Scientist of RRL Jorhat.
2. **Dr Mahalakshmi Dutta**, Research Worker of the Medicinal Aromatic & Economic Plants of the laboratory was awarded the Ph D Degree for his thesis titled 'Studies on medico ethnobotany on the plant genetic resources of Jorhat District, Assam, India' by the Dibrugarh University. He worked under the guidance of Dr S C Nath, Scientist MAEP Divn of RRL-Jorhat.
3. **Dr Abdul Wahab**, Research Worker of the Material Science division of the laboratory was awarded the Ph D Degree for his thesis titled 'Isentropic compressibility and transport behaviour of electrolytes in water, methanol and water + methanol mixture' by the Dibrugarh University. He worked under the guidance of Dr S Mahiuddin, Scientist of RRL-Jorhat.
4. **Dr Devojit Bezbaruah**, Research Worker of the Geoscience division of the laboratory was awarded the Ph D Degree for his thesis titled 'Hydrogeomorphological appraisal of the Brahmaputra river channel from Majuli to Kaziranga, Assam' by the Dibrugarh University. He worked under the guidance of Dr P Kotoky, Scientist of RRL-Jorhat.
5. **Dr Gautam Kumar Sarmah**, Research Worker of the Synthetic Organic Chemistry Division was awarded the Ph D Degree for his thesis titled 'Studies on natural terpenoids and their biological screening' by the Dibrugarh University. He worked under the guidance of Dr JCS Katakya, Scientist of RRL-Jorhat.
6. **Dr Manab Sarmah**, Research Worker of the Material Science Division was awarded the Ph D Degree for his thesis titled 'Synthesis, characterization and reactivity of Rh and Ru complexes of N, O, P donor ligands' by the Dibrugarh University. He worked under the guidance of Dr DK Dutta, Scientist of RRL-Jorhat.
7. **Dr Anil Saikia**, Research Worker of the Medicinal Chemistry Division was awarded the Ph D Degree for his thesis titled 'Studies on conjugated enones and their related systems' by the Dibrugarh University. He worked under the guidance of Dr RC Boruah. Scientist of RRL-Jorhat.
8. **Dr Susanta Kr Borthakur**, Research Worker of the Synthetic Organic Chemistry Division was awarded the Ph D Degree for his thesis titled 'Synthesis of some nitrogen sulphur heterocycles of biological importance' by the Dibrugarh University. He worked under the guidance of Dr B N Goswami, Scientist of RRL-Jorhat.
9. **Dr Padma Acharya**, Research Worker of the Natural Products Chemistry Division was awarded the Ph D for his thesis titled 'Chemical investigation of the medicinal plants of South eastern Sub- Himalayan region with

special reference to isoprenoids and flavonoids' by the Dibrugarh University. He worked under the guidance of Dr N C Baruah, Scientist of RRL-Jorhat.

10. **Dr (Ms) Barnali Saikia**, Research Worker of the Chemical Engineering Division was awarded the Ph D Degree for her thesis titled 'Studies on enantioselective membrane for resolution of amino acids and certain therapeutically important racemic compounds' by the Dibrugarh University. She worked under the guidance of Dr N N Dutta, Scientist of RRL-Jorhat.

11. **Dr Jagat C Borah**, Research Worker of the Natural Products Chemistry division was awarded the Ph D Degree for his thesis titled 'Total Synthesis of Bioactive Natural Products and parts thereof using Aliphatic Nitro Chemistry' by the Dibrugarh University. He worked under the guidance of Dr N C Baruah, Scientist of RRL-Jorhat.

12. **Dr Diganta Sarmah**, Research Worker of the Petroleum & Natural Gas division was awarded the Ph D Degree for his thesis titled 'Development of N-alkyl (meth) acrylate (Co) polymers and their performance evaluation on waxy Indian crude oils' by the Dibrugarh University. He worked under the guidance of Dr SD Baruah, Scientist, RRL-Jorhat.

Higher Qualification Acquired

(i) **Mrs Rumi Kotoky**, Tech. Asstt. of Medicinal, Aromatic & Economic Plants division passed the M Sc examination, 2004 of the Sikkim Manipal University, New Delhi through distant learning in the subject Ecology & Environment and obtained a First Class.

(ii) **Shri Mukibur Rahman**, Technical Officer, Planning division passed the M Sc examination, 2004 of the Sikkim Manipal University, New Delhi through distant learning in the subject Ecology & Environment and obtained a First Class.

(iii) **Mrs Lakhimi Borah**, Technical Officer of Analytical Chemistry division passed the M Sc examination in the subject Ecology & Environment from the Indian Institute of Ecology & Environment, New Delhi under Sikkim Manipal University, Gangtok through distant learning and obtained a First Class.

(iv) **Shri Probin Baruah**, Technical Officer passed the Online Certificate Course on Intellectual Property Rights conducted by the Indian Law Institute (Deemed University), New Delhi and obtained a First Class (Grade A).

Visit abroad

Dr Neelima Saikia, Scientist, Biotechnology Division of the laboratory visited China to attend 15th International Conference on Plant Nutrition held at Beijing during 14-19 September, 2005. Dr Saikia also presented a paper titled 'Accumulation of metal content in plants grown in drude oil contaminated soil'.



Dr T C Bora, Scientist, Biotechnology division attended a workshop on 'Unculturable Microbes: Molecular Techniques and Biotechnology Application' at BIOTEC Auditorium, Thailand Science Park, Pathumthani, Bangkok during 9-10 January, 2006. The workshop was organised by National Centre for Genetic Engineering and Biotechnology (BIOTEC) and National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology (MOST). Dr Bora also visited Ramkhamhaem University, Bangkok, Chulalongkorn University, Bangkok and Kasetsart University. Dr Bora also delivered an invited talk on the topic "A novel Microbial Metabolite of Pharmaceutical importance: a report from Indo-Burma hot zone" in the Department of Genetics and Microbiology, Kasetsart University, Bangkok, Thailand and had a detail discussion with the project collaborators Dr Arinthip Thamsapenet and Dr Kannika Duangmal of the same university on the modalities to be followed for extraction of microbial metabolites for ED-INCO collaborative project submitted to European Commission.



Dr Utpal Bora, a CSIR Senior Research Fellow of the laboratory left for Japan for undertaking Post-Doctoral Research at Medicinal Chemistry Laboratory of Gifu Pharmaceutical University, Japan for two years w.e.f 1st November, 2005 with a prestigious JSPS Fellowship.



Training imparted

Training for Trainers and Mastercraft persons

A seven-day training programme for trainers and mastercraft persons of the state was organised in the laboratory during 21-30 March, 2005. The programme was sponsored by the Development Commissioner (Handicrafts), Ministry of Handloom & Textiles, Govt. of India, NE Region, Guwahati. A total of 22 Mastercraft persons from various parts of the state participated in the training which consisted of 13 lecture schedules and 5 practical demonstration classes conducted by resource persons drawn from the institutes like Indian Institute of Entrepreneurship (IIE), Guwahati, Small Industries Service Institute (SISI), Guwahati, Life Insurance Corporation of India (LIC), Development Commissioner (Handicraft), Co-operative Sectors Bank, NABARD, MSEC besides the scientists from RRL-Jorhat.



Training on Mushroom cultivation in Arunachal Pradesh

The RRL Branch at Itanagar conducted a training programme on cultivation of edible mushroom at Jairampur on 12 June, 2005 jointly with RK Massang Memorial Society under a DBT funded project. About 50 participants from Jairampur and nearby areas attended the training.

Workshop on Medicinal Plants of Arunachal Pradesh

RRL Jorhat and its branch at Itanagar organised a workshop-cum-exhibition on "Cultivation, Processing and Marketing of important medicinal plants of Arunachal Pradesh" at Vivekananda Hall of Ramkrishna Mission, Itanagar on 26 November, 2005 under the aegis of National Medicinal Plants Board, New Delhi. Besides the resource persons, a large number of delegates, scientists, academicians and traders from different parts of the North East India, farmers of Arunachal Pradesh participated in the workshop. The inaugural session was presided over by Dr P G Rao, Director, RRL-Jorhat. Sri Newlai Tingkhatra, Hon'ble Minister for Environment & Forest, Mines & Mineral, Govt. of Arunachal Pradesh and Sri Kipa Babu, MLA of Arunachal Pradesh graced the occasion as the Chief Guest and Guest of Honour respectively. Dr P Gogoi, Head, Department of Botany, DR College, Golaghat and Sri Ramesh Maharaj, Secretary, Ramkrishna Mission, Itanagar were among the other dignitaries. Welcoming the audience and the participants, Dr P G Rao, Director, RRL-Jorhat briefed the objectives of the programme and appealed to the delegates to utilize the opportunity and outcome of the programme



by way of interactions with the resource persons for accruing benefits from the medicinal plants. Dr P Gogoi, in his keynote address stressed on the multicultural activities of medicinal plants instead of monoculture so that sustainable income is generated from short-duration crops while long-duration crops will provide income in the longer term. He also emphasised on the need for establishing germplasm banks for in situ preservation of high altitude medicinal plants of Arunachal Pradesh.

Manipur Sub-Station of RRL organised training on Mushroom cultivation

The RRL sub-station at Imphal, Manipur in collaboration with Integrated Shitake Mushroom Producing and Processing Society of Senapati organised a two-day training programme on cultivation of Shitake mushroom during 24-25 August, 2005 for the benefit of marginal mushroom growers and entrepreneurs of Manipur. The programme was jointly supported by the Forest Department, Govt. of Manipur and the Deputy Commissioner of Senapati. A total of 43 participants including those from Nagaland and Mizoram participated in the training.



Training in Biochemistry

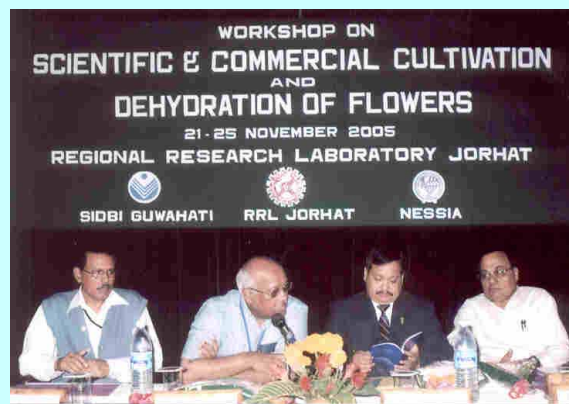
Sri Majil Raj Dutta, M.Sc Biotechnology student of Acharya Institute of Science, Bangalore and Ms Smriti Swapna Borthakur, M.Sc Microbiology student of Administrative Management College, Bangalore were imparted a 3 to 5 week training in the areas of Biochemistry, Immunology and Protein /Peptide Biochemistry respectively under the guidance of Dr B G Unni, Scientist F of Biotechnology division.

Training on Instrumental method of analysis

The Post-graduate Biochemistry students of Assam Agricultural University, Jorhat were given lectures on spectroscopic and chromatographic analysis by the Scientists of Analytical Chemistry Division, the instrumental method of analysis being part of the PG syllabus of AAU.

Workshop-cum-training on Scientific Cultivation and Dehydration of Flowers

With the joint efforts of Small Industries Development Bank of India (SIDBI), Guwahati, the North Eastern Small Scale Industries Association (NESSIA), Jorhat and RRL Jorhat a five-day workshop-cum-training programme on 'Scientific & Commercial Cultivation and Dehydration of Flowers' was organised at RRL during 21-25 November, 2005. The workshop was attended by 32 selected participants comprising of entrepreneurs of flower nurseries and unemployed educated youths from the districts of Jorhat, Golaghat, Sivasagar and Dibrugarh of Assam.



Training on Earthquake Seismology

Training was incorporated to M.Tech student of Computational Seismology, Tezpur University on various topic of earthquake seismology during 5-7 January 2006 at RRL-Jorhat.

Training was also incorporated to four Geologists, Directorate of Geology and Mining, Nagaland on various topic of earthquake seismology during December 2006 at RRL-Jorhat.

Training Attended

(i) Dr P K Bora, Scientist was selected by the DST, Govt. of India for 5 years SERC school programmes on earth science. Dr Bora attended the first module on 'Tectonic Geomorphology' at IIT, Kanpur during March 27, 2005. During

the training programme Dr Bora carried out stratigraphic logging on the bank of the river Ganges and the Yamuna. A total of 25 research scientists belonging to earth science from across the country were selected for this training programme.

(ii) Sri O P Sahu, Technical Officer attended the training on IR Spectroscopy and FTIR conducted by Perkin Elmer (India) Pvt. Ltd. held at Perkin Elmer Technical Centre, Powai, Mumbai during 10-12 May, 2005.

(iii) Dr N C Dey, Scientist F attended the Awareness-cum-Implementation Course on Laboratory Accreditation under ISO 17025 Standard organised by Consultancy Development Centre (CDC) at New Delhi during 4-5 August, 2005.

(iv) Ms D Begum, TO attended the training on Library Development in the North East organised by the Department of Library & Information Science, Guwahati University with the sponsorship of Central Reference Library, Kolkata, Department of Culture, Govt. of India held during 12-16 December, 2005.

(v) Dr H B Singh, Scientist-in-Charge, and Dr C M Senthil Kumar, Scientist, RRL Sub-station, Manipur attended the training on Integrating IPR Culture with R&D' held at I BSD, Imphal organised by NRDC, New Delhi with the sponsorship of DBT, New Delhi.

(vi) Dr (Mrs) Alka Jain, Research Associate, RRL Sub-station, Imphal, Manipur attended the training on Third Entrepreneurship Skill Development at CLRI, Chennai conducted by HRDC (CSIR), New Delhi during 20 February to 23rd March, 2006.

(vii) Dr Pobon Bora, Scientist participated in the "Short Term Course on Engineering Seismology" (sponsored by The Department of Science and Technology, Govt. of India) at CSIR Center for Mathematical Modeling, Bangalore during November 2005.

(viii) Mrs A Sengupta, Scientist received training on "Project Management" at CCMB, Hyderabad organised by HRDC, CSIR during April 28-30, 2005.

Seminar/Symposia/Meeting attended

1. Dr P G Rao, Director, RRL-Jorhat attended the following :

(i) The project review meeting of the Tea Improvement Consortium held at Tea Research Association, Tocklai Experimental Station, Jorhat on 9 April, 2005 while former three are the office bearers of the Association, the latter four attended it as invitees.

(ii) The 1st meeting of Steering Committee on Genetic improvement of *Jatropha curcus* at New Delhi on 8 May, 2005.

(iii) The Supreme Court Monitoring Committee meeting on 'Hazardous Waste Management under the aegies of Ministry of Environment & Forests held at Shillong on 1st June, 2005.

(iv) The Project Evaluation Committee meeting of Technology Development Board, New Delhi held at Hyderabad on 6 June, 2005.

(v) The 2nd GB meeting of Sikkim Science & Technology Council held at Gangtok on 8 June, 2005

(vi) Chaired the 2nd Project Review Monitoring Committee (PRMC) meeting of TIFAC (DST) at Coimbtore on 23 June, 2005.

(vii) The 1st Executive Committee meeting of Tea Improvement Consortium held at Tea Research Association, Tocklai, Jorhat on 12 May, 2005 with Dr B G Unni, Scientist.

(viii) The Research Advisory Council meeting of Central Silk Board as a member on 29-30 June, 2005 by Dr B G Unni, Scientist.

[ix] The meeting on Bioactive Molecules held at New Delhi on August 01, 2005. He also had discussions at CSIR Hqs.

[x] The meeting of RAB at CSIR Complex, New Delhi on August 25, 2005.

[xi] Meeting on Rural Technology Action Group held at Guwahati on September 01, 2005.

[xii] RAB meeting at CSIR Complex, New Delhi on September 04, 2005.

[xiii] The seminar on 'Water 2006' organised by NEERI, Nagpur at Kolkata during September 20-21, 2005.

[xiv] CSIR Industry Meet held at Le Meridian, New Delhi on October 07, 2005.

- (xv) Annual Business Meeting of CSIR held at India Habitat Centre, New Delhi on October 08, 2005.
- (xvi) Valedictory function of the National Children's Science Congress held at Guwahati on October 21, 2005.
- (xvii) Progress review meeting of CSIR-Tezpur University at Tezpur on November 02, 2005.
- (xviii) TIFAC (DST) meeting at Combatore on November 11, 2005.
- (xix) Public meeting on societal development works at BTAD, Jarkhona on November 23, 2005.
- (xx) Inaugural function of the Workshop on cultivation, processing and marketing of medicinal plants of Arunachal Pradesh at Itanagar on November 26, 2005.
- (xxi) Task force meeting for NER at Delhi on November 28, 2005.
- (xxii) Chemical Engineering Congress SCHEMCOM-2005 at IIT Guwahati on December 07, 2005.
- (xxiii) Drug Discovery Group meeting at Delhi on December 08, 2005.
- (xxiv) Conference on IChE at Delhi on December 14, 2005.
- (xxv) RAB meeting at Delhi on December 15, 2005.
- (xxvi) Scientific Advisory Committee meeting of RMRC Dibrugarh on December 16-17, 2005.
- (xxvii) Research Council meeting of Central Food Technological Research Institute, Mysore on December 21, 2005.
- (xxviii) Meeting with Director, RRL Jammu and visit to the lab on December 22-23, 2005.
- (xxix) Directors meeting on 'Change Team' at Delhi on December 24, 2005.
- (xxx) Had discussion with Vice-Chancellor & Academic Registrar of Nagaland University regarding RC meeting arrangement during 2-4 January, 2006.

- (a) During 6-12 January, 2006
- (b) Workshop at GNRC, Guwahati
- (c) Meeting with FINER at Guwahati
- (d) Conference on Project Meeting at Guwahati
- (e) Workshop on Coal in collaboration with FINER at Guwahati
- (f) 32nd Foundation Day celebration of ICAR Complex, Umiam, Meghalaya.
- (g) Workshop on promoting technology development at Tezpur University, Tezpur on 20 January, 2006.
- (h) Attended during 22 to 25 January, 2006
- (i) Academic Council Meeting of RKVM-IAS
- (j) SAC-TRA meeting at Kolkata

2. Shri B J Sarmah, Proj. Asst. attended Int. Seminar on Emerging Trend in Miner. Proc. and Extractive Metallurgy, held at RRL-Bhubaneswar, June 13-14, 2005, and presented a paper.

3. Dr P C Borthakur, Scientist attended 9th NCB International Seminar, National Council for Cement and Building Materials, held at New Delhi during 8-11, Nov. 2005 and presented a paper.

4. Dr D K Dutta, Scientist attended seminar on "Modern Trends in Inorganic chemistry" held at Indian Institute of Technology, New Delhi, during 8-10 December 2005 and presented a paper.

5. Dr S Mahiuddin, Scientist attended National Conference on Thermodynamics of Chemical & Biological Systems held at Guru Nanak Dev University, Amritsar during December 28-30, 2005 and presented a paper.

6. Dr D K Dutta, Scientist attended "Indo-UK Science Network Meeting on "Open and Dense framework heterogeneous catalysis" held at National Chemical Laboratory, Pune, on January 16-18 2006 and delivered an Invited Lecture.

7. Dr Manab Sharma, SRF attended 93 Indian Science Congress held at Hyderabad during 3-7 January 2006, and presented a paper.

8. Dr S Mahiuddin and Mr P Sengupta both Scientists attended a Workshop cum interactive meet on characterization and gainful utilization of North Eastern coal held at Gauhati, 9-10 January 2006.

9. Mr B J Sharmah, Proj. Asstt. Attended 42 nd Annual Conv. Chem. held at Visva-Bharati, Santiniketan, Feb. 8-11, 2006 and presented a paper.
10. Dr D K Dutta, Scientist attended "Winter School on Catalysis" organized by Tezpur University, Tezpur during February 1-14, 2006 and delivered two Invited Lectures.
11. Dr P C Borthakur, Scientist attended 17th Annual General Body Meeting of Material Research Society of India and Theme Symposium, Bio, Biomedical and Natural Materials arrange by Material Research Society of India at Lucknow on 13-15th Feb 2006
12. Mr P Sengupta, Scientist attended International Seminar on Mineral Processing Technology held at Chennai during 8-10 March 2006.
13. Dr P C Borthakur, Scientist attended Executive Sub-Committee Meeting of Assam Science Technology and Environmental Council held at Gauhati on 8th March 2006.
14. Dr P C Borthakur, Scientist attended 9th Governing Body Meeting of Assam Science Technology and Environmental Council held at Janata Bhavan, Dispur Gauhati on 7th April 2005.
15. Dr J Boruwa and Dr N C Barua, Scientists attended the International symposium on advances in organic chemistry (INSOC-2006), organized by School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, India during 9-12 January, 2006.
*Highly stereoselective Nitro-aldol condensation of b-hydroxy aldehyde : A flexible synthesis of antifungal antibiotic Preussin.
16. Mr N Gogoi and Dr N C Barua, Scientists attended the International symposium on advances in organic chemistry (INSOC-2006), organized by School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, India, January 9-12, 2006.
17. Mr P Acharyya and Dr N C Barua, Scientists, attended the International symposium on advances in organic chemistry (INSOC-2006), organized by School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, India, January 9-12, 2006.
18. Dr T C Bora, Scientist attended the `Consultative Meeting on Conservation and Sustainable Utilization of Microbial Resources of NE region : Priorities for networking' organised by Institute of Bioresources and Sustainable Development (IBSD), Department of Biotechnology, Govt. of India held at Imphal, Manipur during 30-31 May, 2005.
19. Dr T C Bora, Scientist attended the brainstorming workshop on `Development of an activity based Module for study of Microorganisms' held at Cotton College, Guwahati jointly organised by ASTEC Guwahati and the Department of Botany, Cotton College, Guwahati, Assam with the sponsorship of NCSTC, Department of Science & Technology, Govt. of India, New Delhi.
20. Dr R K Sharma, Dr P R Bhattacharyya and Dr S N Choudhury, Scientists attended the EOAI International Conference on Prospects of mint in India held at Lucknow during 24-26 June, 2005.
21. Dr S P Saikia, Scientist attended the workshop on Statistical Data Analysis using SPSS held at the Department of Statistics, Guwahati University during 24-28 October, 2005.
22. Dr S C Nath, Scientist attended the 7th Research Advisory Group Meeting of the Rain Forest Research Institute, Jorhat on 26 October, 2005.
23. Dr Paran Baruah, Scientist attended the workshop of ICAR-CABI collaborative project titled `Classical Biological Control of Mikania micrantha with Puccinia spegazzinii : implementation phase' held at Directorate of Research (Agri) on 28 November, 2005.
24. Dr P B Kanjilal, Scientist attended the workshop on Cultivation, Pocessing and Marketing of commercially important medicinal plants of Arunachal Pradesh held at Itanagar RRL Branch on 26 November, 2005 with the sponsorship of NMPB, New Delhi.
25. Dr P B Kanjilal, Scientist attended the Farmers' Mela at Regional Research Station of Assam Agricultural University, Titabor on 14 November, 2005.
26. Dr R K Sharma and Dr P B Kanjilal, Scientists attended the All India Seminar on `Medicinal & Aromatic Plants, harvesting the botanical sources of North East India' organised by the Institute of Engineers (India) Assam, State Centre, Guwahati during 11-12 February, 2006.
27. Dr Mantu Bhuyan, Scientist attended the `Agri-Expo-2006' held at Lucknow during 11-14 February, 2006.

28. Shri G K Bayan, Scientist, RRL Branch, Itanagar attended a national level symposium on 'Prediction methods in Geotechnical Engineering (GEOPREDICT-05)' organised by Civil Engineering Department of IIT, Madras and held at IIT, Madras on 3rd June, 2005.
29. Shri G K Bayan, Scientist, RRL Branch, Itanagar attended the 'NE Regional Workshop on Geotechnical Investigation for Foundation - its importance, implementation, quality control and costing' organised by Indian Geotechnical Society, New Delhi - Guwahati Chapter at Guwahati to commemorate Karl Terzaghi's 123rd Birth Day on 2nd October, 2005.
30. Shri G K Bayan, Scientist, RRL Branch, Itanagar attended the international conference on 'Spatial Data Infrastructures and its role Disaster Management' organised by the Federation of Indian Chambers of Commerce and Industry (FICCI), New Delhi with the sponsorship of Department of Science & Technology, New Delhi held at Chennai during 24-26 October, 2005.
31. Shri G K Bayan, Scientist, RRL Branch, Itanagar attended the national workshop on 'Sensitization of Workshop for North East Region Natural Resource Data Management System (NRDMS)' organised by the Department of Science & Technology, New Delhi and held at IIT, Guwahati during 14-16 February, 2006.
32. Dr S C Dutta, Scientist, RRL Branch, Itanagar attended the national conference on 'Arunachal Pradesh : Tradition in Tradition Linking Ecology, Economics & Ethics' jointly organised by UNESCO, New Delhi, NERIST and others and held at NERIST, Itanagar, Arunachal Pradesh on 14 September, 2005.
33. Shri O P Sahu, Technical Officer attended the seminar on 'Advance Calibration Concept and Practices' organised by Electronics Tests & Development Centre, Guwahati on 7 December, 2005.
34. Dr B G Unni, Scientist attended the following meetings/conferences -
(i) Project review meeting of the Tea Improvement Consortium, Jorhat held at Tea Research Association, Tocklai Experimental Station, Jorhat on 9 April, 2005 to discuss and finalize the project proposals identified during the DBT sponsored workshop held at TES along with Mr S B Wann.
(i) Research Advisory Council Meeting of Central Silk Board as a member during 29-30 June, 2005 at Central Muga & Eri Research and Training Institute, Lahdoigarh.
(ii) Task Force Meeting of the Central Silk Board at Tezpur Central University on 18 July, 2005.
(iii) 'Rshom Krishimela' organised by the Central Muga & Eri Research and Training Institute, Lahdoigarh on 29 October, 2005.
(iv) Gender and Energy Use' organised by the Department of Energy, Tezpur University sponsored by USEFI, Kolkata on 11 November, 2005.
(v) 34th Tea Conference held at Tea Research Association, Tocklai, Jorhat on 28 November, 2005.
(vi) 56th Foundation Day Celebration of USEFI organised by Fulbright Alumni Association of North East Chapter at RRL-Jorhat auditorium on 2nd February, 2006 along with Mr S B Wann, Scientist.
(vii) Research Council meeting at Central Silk Board, Lahdoigarh during 20-21 February, 2006.
35. Ms D Begum and Dr P K Barooah, TOs attended the workshop on E-journal Consortium at IICB, Kolkata organised by NISCAIR, New Delhi held during 23-25 August, 2005.
36. Ms D Begum and Mrs A Goswami, TOs attended the XXV All India Conference of IASLIC at IIT, Madras held at Madras Central Library during 26-29 December, 2005.
37. Dr H B Singh and Dr C M Senthil Kumar, Scientists, RRL Sub-station, Manipur attended the Regional seminar on 'Emerging Scenario of Patent Protection, Valuation and Commercialization' organised by NRDC, New Delhi with the sponsorship of Patent Office, Kolkata and held at IBSD, Imphal on 26 February, 2006.
38. Dr H B Singh, Scientist attended the 'Science Meet 2005' held at Khuman Lampak Main Stadium, Imphal during 11-15 May, 2005 organised by Manipur Science & Technology Council with the sponsorship of NCSTC, New Delhi.
39. Shri Dip Saikia, TO and Dr P G Rao, Director, RRL-Jorhat attended the Global Conference on 'Challenges and Opportunities in Globalizing Banana - the Golden Fruit' held at World Trade Centre, Mumbai on 20 May, 2005 organised by Federation of Indian Chambers of Commerce & Industry (FICCI) in association with the Ministry of Horticulture, Govt. of Maharashtra.
40. Dr (Mrs) Neelima Saikia, Scientist attended the 8th International Symposium on 'Microbiology of Aerial Plant Surfaces' held at St. Catherine's College, Oxford, UK during 24-27 July, 2005.
41. Dr P C Tamuly, Scientist attended the following meetings/conferences/workshops -
41. Dr P C Tamuly, Scientist attended the following meetings/conferences/workshops -
(i) CSIR-WIPO Workshop on 'Negotiating Technology Licensing Agreement' organised by the World Intellectual

Property Organisation (WIPO) in association with CSIR at Habitat World, India Habitat Centre, New Delhi during 4-8 July, 2005.

(ii) CSIR-Industry Meet held at Le Meridian, New Delhi on 7 October, 2005.

(iii) Annual Business Meeting of CSIR held at India Habitat Centre, New Delhi on 8 October, 2005.

(iv) Workshop on 'Promoting Technology Development, Utilization and Transfer' held at Tezpur Central University on 20 January, 2006.

(v) Regional conference on 'Environment & Forest of N E Region' held at Shillong on 10 February, 2006.

(vi) 'Contract Research & Manufacturing' organised by Marcus Avans at Mumbai during 25-26 April, 2005.

(vii) 'Patent Protection, Valuation and Commercialization' organised by NRDC, New Delhi and IBSD, Imphal, Manipur held during 15-16 February, 2006 along with Shri Probin Baruah, TO.

42. Dr Paran Baruah, Scientist attended the brain storming session on 'Zingiberaceae - Biotechnological Intervention for Improved Planting Material and Product Development' organised by National Bioresource Development Board, Department of Biotechnology, Govt. of India held at New Delhi on 29 July, 2005.

43. Dr R C Boruah, Scientist attended the following meetings/conferences -

(i) International Conference on Organic Synthesis and Process Chemistry (OSPC 2005) at I ICT, Hyderabad during April 01-03, 2005.

(ii) ACS-CSIR Joint International Conference OCCB 2006 at NCL, Pune during January 06-08, 2006.

(iii) 75th Annual Session of the National Academy of Sciences, India at Pondicherry University, Pondicherry during December 10-11, 2005.

(iv) Pharmaceutical EXPO 2005 at HI TEX CITY, Hyderabad during December 02-04, 2005.

(v) Second International Symposium on Green/Sustainable Chemistry at Delhi University, Delhi during January 09-13, 2006.

(vi) Indo-US Workshop on Technopreneurship in Academia and Industry at Shangri La Hotel, New Delhi during January 23-25, 2006.

(vii) R&D Management Conference on Innovation : A Route to Competitiveness in Global Economy at Hotel Le Meridian, New Delhi during March 03-04, 2006.

(viii) "Mathematics Talent Search" as Chief Guest at Sankardeb Seminary School, Jorhat on February 19, 2006.

44. Sri B P Baruah and Sri J J Bora, Scientists attended the Energy Summit V 2005 as a Resource Person held at Assam Administrative Staff College, Khanapara, Guwahati during 4-5 October, 2005 under the aegis of North East Chambers of Commerce & Industry.

45. Sri B P Baruah, Scientist attended the following meeting/conference -

(i) 25th State Geological Programming Board meeting at DGM Office, Dimapur, Nagaland.

(ii) Regional Conference on Energy & Environment, organised by MOER, Regional Office at Shillong.

46. Dr Paran Baruah, Scientist attended the seminar on 'Biological Management of Pests and Diseases' organised by IRAB-KIRAB, Dibrugarh on 26 January, 2006 as a Resource Person.

47. Dr Paran Baruah, Scientist attended the 14th Research Advisory Council meeting of the Central Muga & Eri Research and Training Institute, Lahdoigarh of Central Silk Board, Bangalore held during 20-21 January, 2006.

48. Dr Panchali Bandyopadhyay, Research Associate, attended the 34th Tocklai Conference - Strategies for Quality during 28-30 November, 2005.

49. Sri D C Saikia, Technical Officer attended 'Gender Sensitisation Programme' organised by National Bank of Agricultural and Rural Development (NABARD) held at Jorhat on 31 October, 2005.

50. Dr T C Bora, Scientist attended the consultative meeting at IBSD, Imphal, Manipur and participated in formulating project on 'Standardization of Production Technology for Quality Fermented Food of N E region and its Value Addition' during 3-5 February, 2005.

51. Sri R Duarah, Scientist participated DST-PAMC meeting at Darjeeling on 11 July 2005.

52. Dr S Baruah, Scientist participated DST-PAMC meeting at Darjeeling and Manipur University, Imphal during 8 June, 2005 and 19 July, 2005 respectively.

53. Dr J C Sarma, Scientist has attended the following meetings -

- (i) Collectors and Extractors meeting of CSIR coordinated project on bioactive molecules held during October 14-18, 2005 at RRL Jorhat.
- (ii) Apex Committee meeting of CSIR coordinated project on bioactive molecules held on February 07, 2006 at New Delhi.
- (iii) Kick-off meeting of the newly launched Golden Triangle Partnership Project on February 06, 2006 at New Delhi.
- (iv) PAC (Organic Chem.) meeting of DST on February 24, 2006 at IIT, Kharagpur.

54. Dr P K Chowdhury, Scientist has attended the following meetings -

- (i) Collectors and Extractors meeting of CSIR coordinated project on bioactive molecules held during October 14-18, 2005 at RRL Jorhat.
- (ii) International seminar at the 8th Asian Textile Conference (ATC-8) held during May 08-10, 2005 at Engineering Department, AMIR-KHABIR of Technology, Tehran, Iran.

55. Dr Neelima Saikia, Scientist attended 8th International Symposium on Microbiology of Aerial Plant Surface organised by St.Catherine's College, Oxford, U K during July 24-27, 2005.

56. Dr D K Dutta, Scientist(NPCD) has attended the Collectors and Extractors meeting of CSIR coordinated project on bioactive molecules held during October 14-18, 2005 at RRL Jorhat.

57. Dr S D Baruah, Scientist the following seminars/meetings -

- (i) Indo-Belarus seminar on "Bitumen emulsion and cold mix technologies" at CRRRI, New Delhi on October 18-19, 2005.
- (ii) Monitoring Committee meeting of CSIR Network Project on "Development of novel polymeric materials at NCL, Pune during December 17-18, 2005.
- (iii) Scientific Advisory Committee meeting of Ministry of Petroleum & Natural Gas at BPCL, Mumbai on July 07, 2005.

58. Dr Prajapati, Scientist attended the Joint International Conference on Advances in Organic Chemistry and Chemical Biology held at ICT, Hyderabad during January 11-12, 2006 and presented a paper.

Talks Delivered

1. Dr T C Bora, Scientist was invited/delivered the following -

- (i) As a Resource Person to deliver four lectures in Refresher Course organised by the Department of Botany and Academic Staff college, Guwahati University during 15-16 June, 2005 which was attended by the faculty members and college teachers.
- (ii) As a Resource Person to deliver four lectures in Refresher Course organized by the Department of Botany and Academic Staff College, Gauhati University during 15-16 June, 2005 which was attended by the faculty members and college teachers, on the topics: (a) Isolation, screening & characterization of microbial strains, (b) Microbial metabolites of pharmaceutical importance, (c) Microbial Diversity of NE India, (d) Pesticide & Environments.
- (iii) A lead talk on "Bioprospecting Microbial resources of Indo-Burma hot zone: Potentiality and Prospects" in National Seminar on Value addition to Bioresources of North-East India : Post harvest Technology and cold chain, organized by the Department of Botany, Gauhati University and ASTEC, Govt. of Assam on 19-21 May, 2006.
- (iv) A talk on " Microbial resourcess of North-East India: Potentiality and Prospects" in the Department of Botany, Arunachal University, Arunachal Pradesh, on 17th June, 2006.
- (v) A talk on the topic "A Novel Microbial Metabolites of Pharmaceutical importance: a report from Indo-Burma hot zone" in Department of Genetics and Microbiology, Kasetsart University, Bangkok, Thailand, on 12th January, 2006.

2. Dr T C Sarma, R C Saikia, M Chutia and J J Mahanta delivered a talk on 'Studies on root biomass production of Java citronella and its associated changes in soil environment and oil yield' in the national seminar on 'Environment and Sustainable Development' organised by Rangia College under the aegis of UGC, New Delhi during 10-11 September, 2005.

3. Dr T C Sarma, Dr P R Bhattacharyya, Dr P B Kanjilal, Scientists and Dr A K Bordoloi, TO delivered a talk on 'Scientific & Commercial Cultivation of Annual Flowers - Agrotechnology Promotion, Price Fixation and Marketing' at the workshop cum training on 'Scientific & Commercial Cultivation and Dehydration of Flowers' held at RRL organised jointly by SIDBI, Guwahati, NESSIA and RRL during 21-23 November, 2005.

4. Dr T C Sarma, Scientist RC Saikia, M Chutia, JJ Mahanta delivered a talk on 'Influence of leaf blight disease on yield of oil and its constituents of Java citronella and in-vitro control of the pathogen using essential oil at national

seminar on 'Current Trend in Crop Disease Management for Improving Productivity' jointly organised by Indian Phytopathological Society, Eastern Zone and RRL-Jorhat during 20-20 January, 2006.

5. Dr Paran Baruah, Scientist delivered the PS Bharali Memorial Lecture on 'Biological Management of Pests and Diseases' organised by IRAB-KIRAB of Dibrugarh on 25 January, 2005.

6. Shri O P Sahu, Technical Officer delivered a talk on 'The Dual Nature of Light' in the seminar organised by Vivekananda Kendra Shiksha Prasar Vibhag at Laipuli, Tinsukia during 2-4 October, 2005.

7. Dr B G Unni, Scientist delivered the following lectures -

(i) 'Recent development in Molecular Biology and Biotechnology' at the Army School, Rowrah, Jorhat on 10 May, 2005.

(ii) On Molecular and functional properties of insect neuropeptides at Defence Reserch Laboratory, Tezpur on 9 July, 2005.

(iii) For Nagaland University M Sc students in the area of Cell and Molecular Biology on 10 and 11 August, 2005 at the Lumami Campus, Mokokchung, Kohima on the invitation of the Vice Chancellor of the university.

(iv) 'Antibacterial proteins and its functional properties' in the seminar of 17 National Congress of Parasitology held at Regional Medical Reseach Centre, N E Region, Dibrugarh on 24 October, 2005.

(v) 'Neurochemical Techniques' in the international workshop on 'Neurochemical Techniques' organised by the Society of Neurochemistry of India held at Madras University, Chennai on 6 December, 2005.

(vi) 'Bioassy of Insect Neuropeptides' in the symposium 'Emerging Trends in Neurosciences & XXIII Annual Meeting of the Indian Academy of Neurosciences held at the convention centre of National Institute of Medical Health and Neurosciences, Bangalore during 11-14 December, 2005.

(vii) 'In-vitro and In-vivo studies of antibacterial proteins from non-mulberry silkworms' in the 20th International Congress on Sericulture Commission held at Taj Hotel, Bangalore during 15-17 December, 2005.

(viii) 'Recent Development in Molecular Biology and Biotechnology' in the 'Pharmacists Week' of the Institute of Pharmacy, Assam Medical College, Dibrugarh on 30 November, 2005.

(ix) 'Properties of folk medicinal plants with respect to Herbal and Antibacterial activities' in the international symposium on Medicinal Plants and Herbal Products in Biomedicine and their efficacy in the present era & XXVI the annual conference of Indian Association of Biomedical Scientists of India' held at Science City, Kolkata during 25-27 November, 2005.

(x) 'The Properties of Biotechnological Tools in Health Sector' in the MEDESAT conference at Air Force Hospital, Jorhat on 11 March, 2006.

8. Dr H B Singh, Scientist, RRL Sub-station, Imphal, Manipur delivered the following talks -

(i) on (a) Prospects on cultivation of medicinal plants in Manipur and (b) Cultivation prospects of aromatic plants in Manipur at the Institute of Cooperative Management held at Imphal under the aegis of Farmers' Agri-Business Consortium, New Delhi and MANAGE, Hyderabad during 26 July to 6 August, 2005.

(ii) On 'Concept of Biodiversity Hotspots' in the Two-days State Level Conference on Plant Resources of Indo-Burma Hotspot Region for Sustainable Development held at Modern College, Imphal under the aegis of UGC of North Eastern Chapter, Guwahati.

9. Dr R C Boruah, Scientist delivered the following talks -

(i) An oral presentation on Pyridine synthesis at the IUPAC sponsored Second International Symposium on Green/Sustainable chemistry at Delhi University during January 10-13, 2006.

(ii) On Drug Development from Natural Resources at the seminar organised by Gargaon College, Sibsagar on December 28, 2005.

10. Sri R Duarah, Scientist, delivered lectures on the following -

(i) As a resource person under UGC sponsored workshop on : 'Earthquake Hazard and North- East India' at Department of Applied Geology, Dibrugarh University on 28th March , 2005.

(ii) On "The present status of seismic monitoring in NER, India" in Brainstorming session of monitoring of seismicity, (sponsored by DST, New Delhi) organized at RRL-Jorhat on 1st September, 2005.

11. Dr Dipak Kr Dutta, Scientist delivered lectures on the following -
- (i) On 'Supported clay based solid acid catalysts for organic reactions' at the Indo-UK Science Networks Networks meeting on Open and Dense Framework Heterogenous Catalysis' held at National Chemical Laboratory, Pune during January 16-18, 2006.
 - (ii) On 'Electron rich rhodium complexes : efficient carbonylating catalysis' at Winter School of Catalysis held at Tezpur University during February 01-14, 2006.
 - (iii) On 'Clay based solid acid catalysts' at Winter School of Catalysis held at Tezpur University during February 01-14, 2006.
11. Dr Saurabh Baruah, Scientist, delivered the following lectures -
- (i) As a resource person under UGC sponsored workshop on : Earthquake Hazard and North- East India" at Department of Applied Geology, Dibrugarh University on 28th March , 2005.
 - (ii) " Physics of the earthquake source " at Regional Science Congress, Golaghat on 11 September, 2005.
 - (iii) "I mpact from Science in Antarctica " at Debicharan Baruah Girls College on 11 November, 2005 and Bahona College on 25 May, 2005.
12. Dr S Baruah, Scientist presented a brief review of the ongoing project in brainstorming session of monitoring of seismicity, (sponsored by DST, New Delhi) organized at RRL-Jorhat on 1st September, 2005.
13. Dr Ratul Saikia, Scientist Biotechnology Division delivered a talk on Molecular Characterization of Fusarium oxysporum f. sp. ciceri Causing Wilt of Chickpea, in National seminar on Current Trends in crop disease Management for Improving Productivity, 19-20 January, 2006, organized by Indian Phytopathological Society: Eastern Zone at Regional Research Laboratory, (CSIR) Jorhat, Assam.
14. Mr Deep Kumar Gogoi, SRF, Biotechnology Division delivered a talk on "Evaluation of Antimicrobial properties of endophytic fungus isolated from Taxus sp. of Towang, Arunachal Pradesh and its bio-control properties", in National Seminar on Current Trends in Crop Disease Management for Improving Productivity, 19-20 January, 2006 and organized by Indian Phytopathological Society: Eastern Zone at Regional Research Laboratory, (CSIR) Jorhat, Assam.

Honours/Recognition/Nomination

Awards

Dr R C Boruah, Scientist F was awarded the Fellow of National Academy of Sciences (FNASc), India from the year 2005.



Dr Dileep Kumar BS, Scientist was awarded the Dr Biraj Mohan Das Memorial Award of Assam Science Society for his contribution in Life Sciences for the year 2005'



Dr B S Bhau, Scientist was awarded the prestigious Y S Murthy Medal of the Indian Botanical Society(I BS), Rajasthan for the year 2005.



Dr B G Unni, Scientist F was awarded the Best Research Paper Presentation Award in the area of Life sciences in the Second International Congress of Chemistry and Environment held at Indore during 24-26 December, 2005.



Ms Swarnalee Dutta, Research Scholar was awarded the Prof M L Narashimhan Merit Award of the Indian Phytopathological Society for the year 2005.



Fellowship

Dr Utpal Bora, SRF was awarded the Fellowship from Japan Society for Promotion of Science (JSPS) for undertaking Post Doctorate Fellowship at Medicinal Chemistry Laboratory of Fifu Pharmaceutical University, Japan.



S & T SERVICES AND FACILITIES INSTALLED

CHEMICAL

Services :

- (i) Petroleum products were tested and reports were provided to different user agencies and parties on payment basis.
- (ii) A large number of testing of water samples, soil samples, edible oil, furnace oil, food staff, natural products, etc.

were done and reports were provided to about 200 parties including those of public and private sectors like OIL, ONGCL, Coal India Ltd., SDO(Civil), Hindustan Paper Corporation, Directorate of Supply and Transport, Garrison Engineer (MES), NEEPCO Ltd., Assam Tea Corporation, Tea gardens, Parry Agro Industries Ltd., Directorate of Geology & Mining, Numaligarh Refinery, Assam Petrochemicals Ltd. and a host of private industries and manufacturing house.

The total earning from all these services was worked out to be around Rs 8.10 lakh during the period under report.

(iii) A large number of conventional(coke, coal, furnace oil, etc) and non-conventional fuels (bio-mass) were tested and evaluated for different user agencies and parties (Public & Private) of N E Region on payment basis.

Facilities

(a) Thermomechanical Analyzer (Perkin Elmer Instruments Diamond Series)Unit.

The TMA Unit was installed in the laboratory. It is a powerful and versatile thermal analyzer that provides mechanical property measurement on a board variety of materials from 150-600oC. The TMA unit incorporates high quality precision mechanics and offers resolution in the nanometer range, it can also measure the very slightest dimensional changes in samples as a function of temperature, time or force. With the help of TMA, the most varied sample geometries can be measured in the expansion, penetration or tension modes.

Features :

Used to measure the stress and strain of polymers and display the results in terms of time and temperature. The TMA is used to measure thermal, mechanical characteristics such as thermal expansion, contraction and softening. The diamond TMA is designed such a way that highly calibrated measurements can be performed quickly and easily.

Use

The TMA Unit is a powerful and versatile thermal analyzer that provides mechanical property measurement on a broad variety of materials from -150 to 600oC. The TMA unit incorporates high quality precision mechanics and offers resolution in the nanometer range, it can also measure the very slighted dimensional changes in samples as a function of temperature, time or force. With the help of TMA, the most varied sample geometries can be measured in the expansion, penetration or tension modes.

(b) Microprocessor UV-Visible

Features :

A microprocessor based UV-Visible Spectrophotometer model GS-5705 of EC, Hyderabad, having range 190 nm to 1400 nm was installed and calibrated on 14/12/2005.

Optimizing the water quality of ONGC water treatment plant

The water treatment plant at ONGC Cinnamara Colony was inspected by RRL team for optimizing the water quality of the water treatment plant at their residential cum office complex. Operational parameter of the treatment plant which has a capacity of 4.5 Lakh litre per day was investigated and remedial measures suggested for improving the quality of drinking water. Similar investigation was carried out for a second water treatment plant of capacity 1 lakh litre in the AB-Type complex of the ONGC Colony. Partial implemenation of RRL's recommendations improved the treated water quality of the plant and the iron content of the water came down from 3.6 ppm in the raw water to about 0.69 ppm in the treated water. Further implementation of the recommendations were in progress and this would greatly benefit the residents of ONGC colony who are dependent on the water supply from this treatment plant.

(c) Proximate Analyser

A Proximate Analyser was installed fir determination of proximate analysis of coal, coke, bio-mass and liquid fuels.

(d) Energy Dispersive XRF(P)

An EDXRF(P) was installed for detection of elements from Na to U in coal, oil, soil, sediments, effluents, etc.

Beneficiaries of the Testing/Analytical/Evaluation services

The beneficiaries of the Testing/Analysis/Evaluation of materials during the year included Oil India Limited, Oil & Natural Gas Commission, Supply & Transport Arunachal Pradesh, Assam Urban Water Supply & Sewage Board, GAIL (India) Ltd., Coal India Ltd., Assam Petrochemicals Ltd., NEEPCO Ltd., Tea Gardens, Government & Autonomous Institutions of North East, Educational institutions including universitites of North Eastern region, National Building

Corporation, Hindustan Paper Corporation, Cachar Paper Mill, Assam State Forest Department, DGM, Nagaland and several private entrepreneurs. and commercial firms. The materials evaluated by the Analytical Chemistry division included feed, food, drinking water, fertilizer, micronutrients, agrochemicals including pesticides, edible and essential oils, the materials analysed by the Material Science division included cement, soil, lime, iron ore, siliminite, sand, etc., the evaluated by the Biotechnology division included water and wood samples and the materials tested and analysed by the Cellulose, Pulp & Paper section included cloths, pulp, paper and paper products, timber, etc. The Applied Civil Engineering division evaluated the engineering properties of different building and road materials for quality construction while the General Engineering division evaluated the rod, iron samples, etc. The Coal Chemistry Division evaluated conventional and non-conventional fuels for gainful utilization in the industrial and domestic sectors.

ELECTRONICS & INSTRUMENTATION

Services :

The laboratory set-up Testing and Calibration facilities for measuring equipments to provide services to inside and outside parties specially in N E region

Features :

The main Calibration and Testing unit (Multi-product Calibrator 5520A) was installed in the laboratory with accessories. This enabled the laboratory to get standard measurement on electrical parameters (Current, voltage, resistance), Pressure and Temperature. The laboratory is in the process of giving Testing and Calibration facilities in inside and outside parties in National standard as per International Standard.

Facilities :

1. **LAN** (Local Area Net Work) - To provide speedy communication inside the laboratory.
2. **INTERNET** Connectivity in all modes : Easy access to outside world and communication
3. **CCTB** (Closed Circuit TV) : To provide facilities for Official notice/memo display at various places, video address system and Broadcasting and Surveillance.
4. **ISDN** Telephone Exchange : Internal Telephone Network system for the entire laboratory and colony and with few junction lines from BSNL Exchange for incoming and outgoing facilities for the users.

NORTH EAST INSTITUTE OF SCIENCE & TECHNOLOGY

(Formerly Regional Research Laboratory, Jorhat)

(A constituent establishment of CSIR)

Jorhat-785006(Assam)

[HOME](#)

RRL Jorhat Patents : 2005-2006

Filed in India

Application : No. 0382DEL 2006

Title : A process for the preparation of Vanillin from agricultural waste

Inventors : Naleen Borthakur

Filing Date : 13/02/2006

Application No. : 0384DEL 2006

Title : An improved and green method for selective oxidation of alcohols to aldehydes and ketone in water

Inventors : Dilip Konwar, Pranjal Gogoi and Saikat Das Sharma

Filing Date : 13/02/2006

Application No. : 0612DEL 2006
Title : A novel method for preparation of methyl ricinoleate from castor oil
Inventors : Amrit Goswami, Ram Nath Das and Naleen Borthakur
Filing Date : 08/03/2006

Application No. : 0512NF 2002
Title : A device for the collection of essential oils from hydro-distillation of aromatic plant material.
Inventors : Jibon Chandra Sarma Katakya, Subhan Chandra Nath and Nabin Saikia.
Filing Date : 09/03/2006

Application No. : 0668DEL 2006
Title : A process for the production of some 3,4-dihydropyrimidin-2-ones and their 2-thioxianalogues
Inventors : Manabjyoti Bordoloi and Dipak Kr Roy
Filing Date : 10/03/2006

Application No. : 0782DEL 2006
Title : An improved process for manufacture of alluminium foil laminated jacquard board of high strength
Inventors : S R Ghosh and C N Saikia
Filing Date : 22/03/2006

Application No. : 0762DEL 2006
Title : Intercalated clay metal nanoparticles supported composites useful as catalyst and a process for the preparation thereof
Inventors : Dipak Kr Dutta and Omar S Ahmed
Filing Date : 22/03/2006

Application No. : 0765DEL 2006
Title : An improved process for the preparation of Barbituric acids or its derivatives using microwave irradiation in solvent free condition
Inventors : Pulakjyoti Bhuyan, Harsha Narayan Bora and Ipsita Devi
Filing Date : 22/03/2006

Application No. : 0778DEL 2006
Title : A process for carbonylation of benzyl alcohol
Inventors : Dipak Kr. Dutta, Manab Sharma and Pratap Chutia
Filing Date : 22/03/2006

Application No. : 0764DEL 2006
Title : A novel enzyme mediated process for the preparation of 2-aminobenzophenones
Inventors : Dipak Prajapati, Kushal Chandra Lekhok, Romesb Chandra Boruah, Sharbani Majumdar and Tarun Chandra Bora
Filing Date : 22/03/2006

Application No. : 0784DEL 2006
Title : A device for plucking from higher elevation of trees, creepers operating from the ground
Inventors : Dilip Kumar Dutta and Jayanta Jyoti Bora
Filing Date : 22/03/2006

Application No. : 0765DEL 2006
Title : A process for the preparation of a surface active agent useful as chemical additive polyelectrolyte for the removal of alluminous gangue minerals from ore fines
Inventors : Sekh Mahiuddin, Ajit Chandra Baruah and Prakash Chandra Borthakur
Filing Date : 22/03/2006

Application No. : 0335NF2005
Title : Synthesis of novel pyrrolo (1',2':1,6),-piperidino(1',2':1,6) tetrahydropyrido (2,3-B)-quinoline
Inventors : Pulak Jyoti Bhuyan, Ipsita Devi and Pabitra Kumar Kalita
Filing Date : 30/03/2006

Granted in India

Application No. : 0540 DEL 1999
Title : A method for simultaneous recovery of Cphalosporin-C and deacetyle Cphalosporin-C from fermentation broth
Inventors : N N Dutta, G C Sahoo, Samiran Borthakur and R L Bezbaruah
Grant Date : 09/09/2005
Patent No. : 192843

Application No. : 0041 DEL 2001
Title : An improved process for the preparation of food grade Sodium benzoate

Inventors : K P Singh, P Phukon and A Goswami
Grant Date : 09/09/2005
Patent No. : 192847

Application No. : 0166 DEL 2001
Title : A process for the isolation of a new phytoecdysteroid
Inventors : M Bordoloi and V Chakraborty
Grant Date : 09/09/2005
Patent No. : 192848

Application No. : 2713 DEL 1998
Title : A process for the preparation of fungicide
Inventors : B Bezbaruah and N Saikia
Grant Date : 14/11/2005
Patent No. : 192830

Application No. 0213DEL 2000
Title : A process for the preparation of string annetherpyrido (A,16-6) steroids as potential compounds from cinnamomun spices
Inventors : R C Boruah, J S Sandhu, Sahadat Ahmed and Utpal Sarmah
Grant Date : 09/12/2005
Patent No. : 192970

Application No. : 0214 DEL 2001
Title : A process for extraction of Essential oil containing mainly terpenoid compounds and cinnamoldehyde from cinnamomun spices
Inventors : S C Nath, A Boruah, A K Hazarika and JCS Katakya
Grant Date : 23/12/2005
Patent No. : 193291

N F No. : 0224NF1995/IN
Title : An improved process for the oxidation of pseudodiosgen in diacetate to plosone for the production of 16-dehydropregnenolone acetate
Inventors : A Goswami, R Katakya, RC Rastogi and AC Ghosh
Grant Date : 06/01/2006
Patent No. : 193534

N F No. : 0151NF2000/IN
Title : A process for assymetric synthesis of a chiral glycerol derivative useful for the production of optifcally pure cardiovascular drugs
Inventors : P Goswami, L Kanwar, NN Dutta, Amrit Goswami, AK Hazarika, BK Gogoi and Swapnali Hazarika
Grant Date : 20/01/2006
Patent No. : 193956

N F No. : 0410NF2002/IN
Title : A new process for synthesi of some new steroid 16a,17a-D-isoxazoline derivatives
Inventors : Papori Goswami and P K Chowdhury
Grant Date : 20/01/2006
Patent No. : 193958

N F No. : 0116NF2001/IN
Title : 2-methylheptylisonicotinate as novel antibiotic
Inventors : G N Bordoloi, B Kumari, MJ Bordoloi, MK Roy and TC Bora
Grant Date : 30/01/2006
Patent No. : 194356

N F No. : 0063NF2000/IN
Title : An improved process for the production of 2-hydroxyketone
Inventors : V Chakraborty and M Bordoloi
Application No. : 0061 DEL 2001
Grant Date : 10/02/2006
Patent No. : 194361

N F No. : 0009NF2000/IN
Title : A process for the production of 2-methylheptylisonicotinate
Inventors :: G N Bordoloi, Babita Kumari, MJ Bordoloi, TC Bora and M K Roy
Grant Date : 17/02/2006
Patent No. : 194684

N F No. : 0180NF1998/IN

Title : An improved process for the preparation of 20-oxopregnane compounds

Inventors : P K Chowdhury, B Borah, S Hazarika

Grant Date : 11/01/2005

Patent No. : 192295

PUBLICATIONS : 2005-2006

Chapter in Book

1. NATH S C, DUTTA M L, PURKASHTHA J : Ethno-medico botany of the Shyams of Assam, India, In- Medicinal plants - ethno-botanical approach, ed by P C Trivedi, Agrobios (India) Publication, Jodhpure, 2005, p-243-50.
2. UNNI B G : Radiochemical assay and its application with respect to the functional properties of insect neuropeptides and hormones, In- " Awareness programme on application of radio isotops and radiation technology for societal benefit Published by NARRI , Mumbai, 2005, p-99-102.

International Journal

Biological Sciences

1. HAKUR D, BHUYAN M, MAJUMDER S, YADAV A, HAZARIKA L K, BARMAN N, BARUAH AALH, BORA T C: Isolation, characterization, in-vitro antibiotic susceptibility and pesticide tolerance of gut bacteria from rice hispa, *Dicladyspa armigera* (Olivier), *Indian J Microbiology*, 2005, 45(3), p-217-22
2. SAHA P, KRISHNAMURTHI S, MAYILRAJ S, PRASAD G S, BORA T C : *Aquimonas voraii* gen. nov., sp. nov., a novel gammaproteobacterium from a warm spring of Assam, India, *International J Systematic & Evolutionary Microbiology*, 2005, 55 p-1491-1495.
3. SINGH H B, SUNDRIYAL R C : Composition, economic use and nutrient contents of Alpine vegetation in the Khangchendzonga Biosphere Reserve, Sikkim Himalaya, India, Arctic, *Antarctic and Alpine Research*, 2005, 37(4), p-591-601
4. TAMULY P, BARUAH P, NATH S C, LECLARK P A : Essential oil of Eagle wood tree - a product of pathogenesis, *J Essential Oil Research*, 2005, 17(6), p- 601-04
5. UNNI B G, DAS P, DEKA P C : Endocrinological study with the brain of non-mulbury silkworms using *in-vitro* techniques, *Annals of Neuroscience*, 2005, 13(1), p-19-20

Chemical sciences

6. PRAJAPATI D, THAKUR A J : Studies on 6-[(dimethylamino)methylenelaminouracil - a facile one-pot synthesis of novel pyrimido[4,5-d]pyrimidine derivatives, *Tetrahedron Letters*, 2005, 46(9), p-1433-1436
7. SAIKIA P J, DASS N N, BARUAH S D : Cocrystallation behaviour of poly(n-docosyl acrylate) with n-docosanoic acid by x-ray and differential scanning calorimetry studies, *J Applied Polymer Science*, 2005, 97, p-2140-46
8. SAIKIA P J, DASS N N, BARUAH S D : Kinetic study of the atom transfer radical polymerization of n-docosyl acrylate, *J Applied Polymer Science*, 2005, 97, p-2147-56
9. BORAH H N, DEB M L, BORUAH R C, BHUYAN P J : Stereoselective intramolecular hetero-diels-alder reactions of 1-oxa-1,3-butadienes - synthesis of novel annelated pyrrolo[1,2-a]indoles, *TETRAHEDRON LETTERS*, 2005, 46(19), p-3391-3393
10. BORAH H N, PRAJAPATI D, BORUAH R C : A novel indium catalyzed Sonogashira coupling reaction, effected in the absence of a copper salt, phosphine ligand and palladium, *Synlett*, 2005, p-2823-25.
11. BORAH J C, GOGOI S, BORUWA J, BARUA N C : LaCl₃-center-dot-7H(2)O-promoted regioselective ring-opening of epoxides using NaNO(2) in ether-water system - a facile synthesis of 2-nitroalcohols, *SYNTHETIC COMMUNICATIONS*, 2005, 35(6), p-873-878.

12. CHOWDHURY P, DAS A M, GOSWAMI P : Synthesis of some new steroidal [16-a, 17-a-d]-isoxazolines, *STEROIDS*, 2005, 70(8), p-494-498.
13. DAS M R, MAHI UDDI N S : Kinetics and adsorption behaviour of benzoate and phthalate at the α -alumina- water interface : influence of functionality, *COLLOIDS AND SURFACES. A*, 2005, 264 p- 90-100.
14. DEB M L, BHUYAN P J : Uncatalysed Knoevenagel condensation in aqueous medium at room temperature, *Tetrahedron Letters*, 2005, 46(38), p-6453-6456.
15. DEB M L, BHUYAN P J : An efficient and clean synthesis of bis(indolyl)methanes in a protic solvent at room temperature, *Tetrahedron Letters*, 2006, 47(9), p-1441-43.
16. DEVI I, BHUYAN P J : An expedient method for the synthesis of 6-substituted uracils under microwave irradiation in a solvent-free medium, *Tetrahedron Letters*, 2005, 46(34), p- 5727-5729.
17. DUTTA D K, CHUTIA P, WOOLLI NS J D, SLAWI N A M Z : A new series of iodocarbonyl ruthenium (II) complexes with unsymmetrical phosphine-phosphine sulfide ligands of the type $\text{Ph}_2\text{P}(\text{CH}_2)_n\text{P}(\text{S})\text{Ph}_2$, $n = 1-4$: Isolation and structural investigation, *Inorganica chemica acta*, 2006, 359 p- 877-882.
18. DUTTA D K, WOOLLI NS J D, SLAWI N A M Z, KONWAR D, SHARMA M, BHATTACHARYYA P, AUCOTT S M : Rhodium(I) carbonyl complexes of mono selenium functionalized enylphosphino methane and Bis(di- phenylphosphino) amine chelating ligands and their catalytic carbonylation activity, *J Organometallic Chemistry*, 2006, 69 p-1229-34.
19. GOGOI NAMI NITA, BORUWA JOSHODEEP, BARUA N C : A total synthesis of (-)-bestatin using Shibasaki's asymmetric Henry reaction, *Tetrahedron Letters*, 2005, 46(44), p-7581-7582.
20. GOGOI P : Resin-supported sulfonic-acid, *Synlett*, 2005, (14), p- 2263-64.
21. GOGOI P, KONWAR D : Transition metal and organic- solvent free : a highly efficient anaerobic process for selective oxidation of alcohols to aldehydes and ketones in water, *Organic Biomolecular Chemistry*, 2005v3, (19), p- 3473-75.
22. GOGOI P, KONWAR D : Highlights -Anaerobic oxidation of alcohols to aldehydes and ketones in water, *Green Chemistry*, 2005, 7 p-763-64.
23. GOGOI P, KONWAR D : An efficient and one-pot synthesis of imidazolines and benzimidazoles via anaerobic oxidation of carbon-nitrogen bonds in water, *Tetrahedron Letters*, 2006, 47 p-79-82.
24. GOGOI SI DDHARTHA, BHUYAN RANJANA, BARUA N C : Iodine-Catalyzed Conversion of α -Dicarbonyl Compounds into α -Enaminones Within a Minute Under Solvent-Free Conditions, *Synthetic Communications*, 2005, 35 (21), p-2811-18.
25. GOSWAMI A, GOSWAMI J : DMSO-triggered enhancement of enantioselectivity in novozyme [435]-catalyzed transesterification of chiral 1-phenylethanol, *Tetrahedron Letters*, 2005, 46(25), p-4411-4413.
26. KULSHRESTA MONI KA J, SEKAR R, KRI SHNA DHAZARI KA A K, DEY N C, RAO P G : Deposition fluxes of chemical components of fog water at a rural site in North East India, *Tellus.B*, 2005, 57 p-436-39.
27. MAHI UDDI N S, RENONCOURT A, BAUDUI N P, TOURAUD D, KUNZ W : Horseradish-peroxidase activity in a reverse catanionic microemulsion, *Langmuir*, 2005, 21(12), p-5259-5262.
28. SAI KI A A, BORTHAKUR M G, BORTHAKUR M, SAI KI A C J, BORA U, BORUAH R C : Conjugate base catalyzed one-pot synthesis of pyrazoles from α -formyl enamides, *Tetrahedron Letters*, 2006, 47(1), p-43-46.
29. WAHAB A, MAHI UDDI N S : Solvation phenomena of potassium thiocyanate in methanol-water mixtures, *J Solution Chemistry*, 2005, 34(5), p-537-53.
30. WAHAB A, MAHI UDDI N S, HEFTER G, KUNZ W, MI NOFAR B, JUNGWIRTH P : Ultrasonic velocities, densities, viscosities, electrical conductivities, Raman spectra, and molecular dynamics simulations of aqueous solutions of $\text{Mg}(\text{OAc})_2$ and $\text{Mg}(\text{NO}_3)_2$: Hofmeister effects and ion pair formation, *J Physical Chemistry. B*, 2005, 109 p- 24108-120.

Engineering Sciences

31. BORA M M, BORTHAKUR S, RAO P C, DUTTA N N : Aqueous two-phase partitioning of cephalosporin antibiotics: effect of solute chemical nature - SHORT COMMUNICATION, *Seperation and Purification Technology*, 2005, 45(2), p-153-156.

32. SIVAKUMAR V, SWAMI NATHAN G, RAO P G : Studies on the influence of power ultrasound on dye penetration in leather dyeing using photo micrographic analysis, *J Microscopy-Oxford*, 2005, 220 p-31-35.
33. SIVAKUMAR V, SWAMI NATHAN G, RAO P G : Application of power ultrasound in the fatliquoring process, *J American Leather Chem Association*, 2005, 100 p-187-95.
34. VEDARAMAN N, KANNAN C S, BRUNNER G, RAMABRAHMAM B V, RAO P G : Experimental and modeling studies on extraction of cholesterol from cow brain using super critical carbon dioxide, *J Supercritical Fluids*, 2005, 34 p-27-34.

Geosciences

35. RAJENDRAN C P, RAJENDRAN K, DUARAH B P, BARUAH S, EARNEST A : Reply to comment by R. Bilham on "Interpreting the style of faulting and paleoseismicity associated with the 1897 Shillong, North East India earthquake : Implication for regional tectonism", *Tectonics*, 2006, 25(9TC2002), p-1-2.

National Journals

Biological Sciences

1. BARUAH A, NATH S C : A systematic census on the *Cinnamomum schaeffer* (Lauraceae) members growing in North East India, *J Economic & Taxonomic Botany*, 2005, 29(2), p-294-327.
2. BARUAH A, NATH S C, HAZARIKA A K : Essential oil of *Cinnamomum tamala* Nees, - a new chemotype source from North East India, *Indian Perfumer*, 2005, 49(4), p-433-36.
3. JAIN A, ROSHNI BALA S, RAJSHREE K, SHARMA H N, KANJILAL P B, SINGH H B : Matting rush (*Schoenoplectus lacustris*(Linn.) Palla): Status, utility, threat, cultivation and conservation options in Manipur, *Current Science*, 2005, 89(6), p-1018-22.
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