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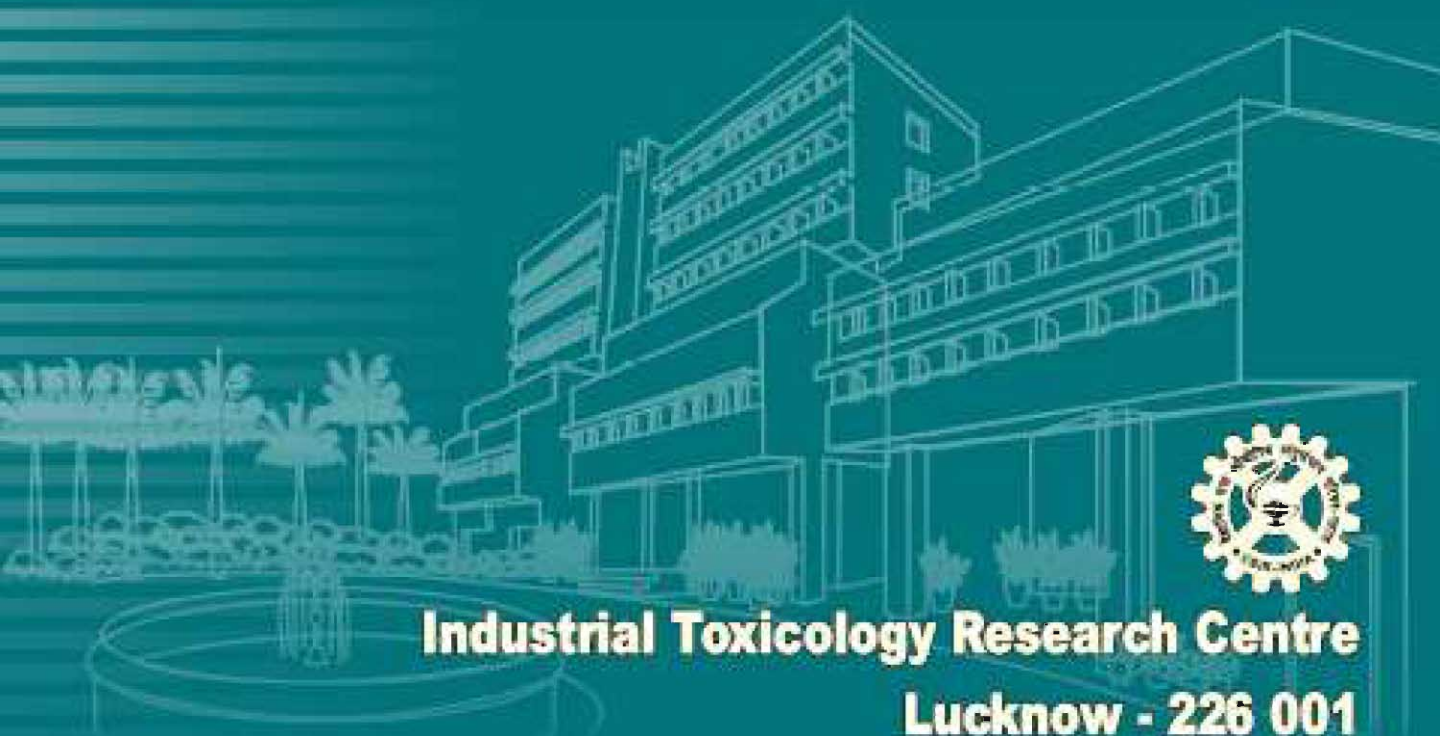

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Contents

निदेशक की कलम से

मुझे औद्योगिक विषविज्ञान अनुसंधान केन्द्र के अप्रैल 2006 से मार्च 2007 का वार्षिक प्रतिवेदन प्रस्तुत करते हुए अतीव प्रसन्नता हो रही है जिसके माध्यम से हम अपने कार्यकलापो को जो शोध सामाजिक कार्यक्रमों तथा उद्योगों की सेवा पर आधारित है, आपके संज्ञात में ला रहा हूँ। सर्वप्रथम मैं डॉ. सी. एम. गुप्ता कि हार्दिक प्रशंसा करता हूँ जिन्होंने निदेशक केन्द्रीय औषधि अनुसंधान संस्थान लखनऊ के पद पर आसीन होते हुए आइ. टी. आर. सी. के निदेशक इन्चार्ज के रूप में जुलाई 2005 से जून 2007 तक केन्द्र का मार्गदर्शन किया। उनके गतिशील मार्गदर्शन में संस्थान ने प्रकाशन, सामाजिक कार्यक्रमों तथा वाह्य धन प्रवाह के क्षेत्र में चँहुमुखी विकास किया। मुझे जून 13, 2007 को इस संस्थान के कार्यवाहक निदेशक का कार्यभार मिला।

प्रस्तुत प्रतिवेदन भी उसी अवधि से सम्बंधित है जब भारक सरकार की दसवी पंचवर्षीय योजना पूर्ण हो रही थी तथा आई. टी. आर. सी. ने भी अपनी इस योजना अवधि की समस्त परियोजनाओं को सफलता पूर्वक पूर्ण कर लिया था। इसमें तेरह नेटवर्क परियोजनाये सम्मिलित हैं, टॉक्सीकोजीनोमिक्स आफ पॉलीमॉरफ़िज्म इन इन्डियन पापुलेशन टू इन्डस्ट्रीयल कैमिकल्स आफ द डेवलपमेन्ट आफ बायोमारकर्स (नोडल प्रयोगशाल के रूप में), पर्यावरण मॉनिटरिंग मिटीगेशन सिस्टम एवं डिवायसिस, एस्थमेटिक एवं एलर्जी डिसआर्डर मिटीगेशन मिशन, नवीनतम वैज्ञानिक हर्बल प्रिप्रेशन फार ग्लोबल पोजिशनिंग, पारम्परिक ज्ञान डिजिटल प्रलेखीकरण एवं पुस्तकालय, प्रीडेक्टिव औषधि यूजिंग रिपीट एन्ड सिंगल न्यूक्लियोटाइड पॉलीमॉरफ़िज्म, जन्तु मॉडल एवं जन्तु प्रतिस्थान्तरित तकनीकी, भौतिकीय यांत्रिक विद्युत एवं इलेक्ट्रॉनिक मानक, हार्डरॉक क्षेत्र में भूमि जल के प्रबन्धन हेतु तकनीकी एवं विधियों का विकास, औद्योगिक अपव्यय का न्यूनतीकरण एवं सफाई, अनुवांशकीय, विकसित खाद्यः एक संदर्भ सुविधा का स्थापनाकरण, अनुवांशकीय विकसित/इन्जीनियर्ड औषधि की सुरक्षा हेतु अतिविकसित सुविधा की स्थापना (जहॉ आई. टी. आर. सी. प्रतिभागी अनुसंधानशाला थी) इसके अतिरिक्त कई अन्य आर. एन. डी. (इन हाउस) कार्यक्रमों तथा वित्तीय अनुदान सहायता प्राप्त उद्योगों तथा परामर्शी शोध एवं सामाजिक कार्यक्रमों को इस अवधि में किया गया। हमें यह सूचित करते हुए अति प्रसन्नता है कि लगभग अपने सभी लक्ष्यों को हमने प्राप्त कर लिया।

अब ग्यारहवी पंचवर्षीय योजना में हम दो प्रमुख शोधकार्यक्रमों को हाथ में लेने जा रहे है जैसे अनुसंधानपरक विषविज्ञान नई रूप तालिका (सुपरा इन्सटीट्यूशनल परियोजना) और नेटवर्क आधारित परियोजना, पर्यावरण परिरोधन : नई तकनीकी प्रदर्शन और मानव स्वास्थ्य पर प्रभाव जहॉ आई. टी. आर. सी. नोडल अनुसंधानशाला है। इसके अतिरिक्त आई. टी. आर. सी. छः अन्य नेटवर्क परियोजनाओं में भी भाग लेगा।

विष अनुसंधान के उभरते क्षेत्रों में अपनी सुविधाओं को उच्चीकृत करते हुए इस वर्ष ''नैनो मैटीरियल टॉक्सीसिटी'' एवं इनसिलिको टॉक्सीकोलॉजी में सुविधाए बढ़ा दी गई हैं। बायोइन्फारमैटिक्स सुविधाओ को भी सुदृढ़ किया गया। इस अवधि में किये गये कुछ विशिष्ट शोध कार्यकलाप निम्नवत हैं :-

- भारतीय जनसंख्या में विभिन्न बिमारियों की प्रवणता और विषैले पदार्थो के प्रतिभिन्न अनुक्रियाओ से सम्बन्धित अनुवांशिक विभिन्नताओ का अध्ययन किया गया। देखा गया कि उत्तर भारतीय जनसंख्या में पालीसाइकिलिक हाइड्रोकार्बन के मेटाबालिजम को प्रभावित करने वाली जीन साइटोक्रोम P4501B1(CYP1B1), ग्लूटाथायोन-एस-ट्रासफरेज (GST) (GSTM, GSTT1 and GSTP1) में पाया जाने वाला सिंगल न्यूक्लियोटाइड पालीमार्फिज्म (SNP) सिर और गर्दन के स्क्वामस सेल कारसीनोमा को बढ़ावा देता है। डोपामिन के र्निविषिकरण और नियंत्रण में भाग लेने वाली जीन पारकिन्सन डिजीज की प्रवणता और उसके कारको को बढ़ावा देती है।

- अनुवांशिक रूप से संशोधित मक्का (MON 810) और सोयाबीन (RR SOYA) में मौजूद ट्रांसजीन (CRY1A(b)) की खोज के लिए पी सी आर प्रोटोकाल विकसित किया गया। इसकी मदद से अनुवांशिक संशोधित फसलों मे पायी जाने वाली ट्रांसजीन खोजी जा सकती है।

- चूहे की त्वचा में ट्यूमर की उत्पत्ति पर कवकीय उपाप्च्य पदार्थ की भूमिका से सम्बन्धित शोध किया गया।

- रिपीटेड फिश फ्राइड आयल (RFFO) के रासायनिक विशलेषण में अनेक कैंसर जनक पालीसाइकिलिक ऐरोमैटिक हाइड्रोकार्बन पाये गये। ऐसा पाया गया कि आर. एफ. एफ. ओ. यकृतीय साइटोक्रोम P450, बेन्जोपाइरिन डी. एन. ऐ. बाइडिंग और कोशिका क्षरण को बढ़ावा देता है।

- रिफैम्पसिन और पाइरोगिलेान जैसे औषधियो द्वारा पैदा की गई यकृतीय विषिकरण के विरूद्ध पादपीय एन्टीआक्सीडेंट सिलिमारिन के प्रभाव का अध्ययन् किया गया।

- ऐसा देखा गया कि सामान्य रूप से इस्तेमाल किये जाने वाले पेय पदार्थो ग्रीन और ब्लैक चाय में मौजूद पालीफिनालिक संघटक चूहे की त्वचा के टयूमर में BAX ट्रांसलोकेशन, साइटोक्रोम c के वाह्य प्रवाह और कैसपेस की सक्रियता के द्वारा कोशीकीय क्षरण को बढ़ावा देते है।

- देखा गया कि ब्लैक चाय में मौजूद पालीफिनाल (BTP) मानव प्रोस्टेट कैंसर कोशिकाओ में G2/M फेज को नियंत्रित करता है। बाद की अवस्था में ये सेल ग्रोथ रेगुलेट्रस ($p21^{waf1/cip1}$ cdc25cyclinB) को नियंत्रित करके कोशीकीय क्षरण को बढ़ावा देता है। ये औषधीय प्रतिरोधक मानव ल्यूकीमिक कोशिकाओ (K562) में कैंसर रोधी औषधियों के अवशोषण को बढ़ावा देता है।

- पौधों मे पाया जाने वाला एलक्लायड 'पाइपेरिन' कैडमियम प्रभावित म्यूरिन स्पलिनोसाइट्स और थाइमोसाइटस में रोग प्रतिरोधकता को नियंत्रित करता है। इसका उपयोग कैडमियम प्रभावित रोग प्रतिरोधक विषाक्तता के विरूद्ध औषधि के रूप में किया जा सकता है।

- कानपुर शहर के विभिन्न जलस्रोतो में मौजूद विभिन्न प्रदूषक और पानी की गुणवत्ता के मानको का अध्ययन क्षेत्रिय प्रतिचित्रण के द्वारा किया गया। औद्योगिक क्षेत्रो में मौजूद दोनो सतही और गहरे जल स्रोतो में विभिन्न विषैले पदार्थो का प्रदूषण पाया गया है।

- विभिन्न जलस्रोतो में पानी की गुणवत्ता के प्रबन्धन और इन्टरोटाक्सीजेनिक ई० कोलाई की जाँच के लिए मालीकुलर बीकन रीयल टाइम पीसीआर नामक तीव्र एवं संवेदनशील परिवीक्षण तकनीक विकसित की गई।

- पर्यावरणीय सुरक्षा और प्रदूषण नियंत्रण हेतू पूअर मेथेनलेटेड डिस्टीलरी ईफलूएंट (पी. एम. डी. ई) के डीकलराइजेशन एवं निर्वीषीकरण हेतु एक आरम्भिक स्तर का नमस्थल निकाय विकसित किया गया।

- एक अध्ययन में ऐसा पाया गया कि जन्म से पहले चूहे को कम मात्रा में लिन्डेन (जो कि एक आरगेनोक्लोरीन कीटनाशी है) देने से प्रौढ़ चूहो में कोई दैहिक प्रभाव नही पड़ता है परन्तु वह उनकी सन्तानो के दिमाग एवं यकृत में मौजूद जीनोबायोटिक मेटाबोलाइजिंग जीन CYPs का अत्यधिक प्रकटीकरण करता है, जिससे उनमे तमाम व्यवहारिक परिवर्तन आते है ।

- भारत में पाये जाने वाले केंचुएँ (Metaphire posthuma) को अपजीवीय पदार्थो की विषाक्तता जाँचने के लिए माडल के रूप में विकसित किया गया।

- आई. टी. आर. सी. ने स्कूल/कालेज विद्यार्थियों को शिक्षित करने के लिए कई सामाजिक कार्यक्रमों को हाथ में लिया, जैसे व्याख्यान, प्रदर्शन, फिल्म शो तथा प्रदर्शनी के माध्यम से इस दिशा में प्रगति की। विद्यार्थियों में वैज्ञानिक मनः स्थिति की प्रोन्नती हेतु अपने गोद लिए दो विद्यालयो में वैज्ञानिक उपकरणों एवं अन्य आवश्यक दी गई सुविधाओं को हमने

यथावत जारी रखा है। आई. टी. आर. सी. ने ''मार्केट वास्केट सर्वे'' को देश के विभिन्न भागों में जारी रखा हैं जिससे खाद्य पदार्थों में मिलावट तथा संदूषण/मिलावट की जानकरी हो सके।

- इस केन्द्र के कई वैज्ञानिकों को विभिन्न सम्मानित मंचो से सम्मान तथा पुरस्कार मिल चुका है। शोधकर्ताओं तथा परियोजना सहायकों ने भी कई राष्ट्रीय तथा अन्तर्राष्ट्रीय सम्मेलनों में भाग लिया तथा उन्हें पारितोषिक प्राप्त हुआ।

- इस अवधि में 127 शोधपत्र प्रकाशित हुए और प्रतिष्ठित पत्रिकाओं में उनकी समीक्षा भी हुयी। इसके अतिरिक्त सात पुस्तको के अध्याय तथा सात मोनोग्राफ भी प्रकाशित हुए। सामान्य प्रभावकारी गुणनखंड प्रति पेपर 1.88 था। इस अवधि में छः शोधकर्ताओं को पी. एच. डी. उपाधि भी प्रदान की गई।

- इस कार्यकाल में केन्द्र को जो सफलता प्राप्त हुई उसके लिए मैं उपने स्टाफ द्वारा दिये गये प्रशंसनीय योगदान हेतु उनका आभार प्रकट करता हूँ और साथ ही आशान्वित हूँ कि सामूहिक प्रयत्नो द्वारा यह विष अनुसंधान में वैश्वी प्रतिस्पर्धात्मक केन्द्र बन जाएँ।

- मैं यह विनम्रतापूर्वक स्वीकार करता हूँ कि उपरोक्त कार्यक्रम कभी सफल नहीं हो सकते थे यदि हमें महानिदेशक सी. एस. आई. आर. की उदारतापूर्वक सहायता न प्राप्त होती। इसके साथ ही कई सरकारी तथा गैर सराकारी एजेन्सी तथा निदेशकों, आर. एण्ड डी. संगठनों जिसमें सी. एस. आई. आर. अनुसंधानशाला सम्मलित हैं का भी आभारी हूँ। मैं प्रो. एम. एस. वैलियाथन, अध्यक्ष तथा अपने रिसर्च काउंसिल के माननीय सदस्यों को भी धन्यवाद देना चाहूँगा जिन्होंने अपने योग्य मार्गदर्शन से हमारे केन्द्र को विकसित किया।

अंत में मैं यह आश्वासन देना चाहूँगा कि हम अपने आदर्श वाक्य ''पर्यावरण एवं स्वास्थय की सुरक्षा एवं उद्योग की सेवा'' के भावों को अपने कार्य में साकार रूप देते हुए, राष्ट्र की हमसे जो अपेक्षाएं है उन्हें पूरा करने का हर सम्भव प्रयास करेंगे।

धन्यवाद**!**

अश्वनी कुमार

From the Desk of Director

I take great pleasure in presenting the Annual Report of 'Industrial Toxicology Research Centre (ITRC)', Lucknow, for the period of April 2006-March 2007, with a view to display our activities based on research work, societal programs and services to the industry. At the outset, I would like to put on record my sincere appreciation for Dr. C.M. Gupta, who in addition to being the director of Central Drug Research Institute, Lucknow, provided his services to ITRC as Director In-charge, from July 2005 June 2007. During his dynamic leadership, the 'Institute' showed an overall progress in terms of publications, external cash flow and societal activities. I was given the charge of Acting Director of ITRC on June 13, 2007.

The period of report coincides with the completion of tenth five year plan of Government of India, and ITRC has successfully completed all the projects of this plan period. These included thirteen network projects namely, *Toxicogenomics of genetic polymorphism in Indian population to industrial chemicals for the development of biomarkers (as nodal lab)*, *Pollution monitoring mitigation systems and devices, Asthmatic and allergic disorders mitigation mission, Newer scientific herbal preparations for global positioning, Comprehensive traditional knowledge digital documentation and library, Predictive medicine using repeat and single nucleotide polymorphisms, Animal models and animal substitute technologies, Physico-mechanical, electrical and electronic standards, Development of techniques and methodologies for exploration, assessment and management of ground water in hard rock areas, Industrial waste minimization and clean up, Establishing genetically modified foods referral facility, Establishing advanced facility for safety evaluation of genetically modified/engineered drugs* (where ITRC was a participating laboratory). Besides several in-house R&D programs, a number of grant-in-aid, industry sponsored consultancy research, and societal programs were also undertaken during this period. I am pleased to inform you that we were able to achieve almost all of our goals.

Now, in the XIth five year plan, we are undertaking two major research programs namely, *Investigative Toxicology: New Paradigms* (Supra Institutional Project) and the network project, *Environmental Contaminants: New Screening Technology and Effects on Human Health*, where ITRC is the nodal lab. Besides these, ITRC will be participating in six other network projects.

In order to upgrade our facilities the emerging areas toxicology, the facilities for nano-material toxicity and *in silico* toxicology were created this year; bioinformatics facility was also strengthened. Some significant highlights of the research activities during this period are as follows:

- Genetic polymorphism in Indian population for differential response to toxicants, and susceptibility to different diseases was studied. SNPs in a polycyclic aromatic hydrocarbon metabolizing Cytochrome P4501B1 (*CYP1B1*), and glutathione S-transferase (*GST*) genes (*GSTM1, GSTT1 & GSTP1*) were shown to modify the suscptibility to squamous cell carcinoma of head and neck in North Indian population**.** Polymorphism in the genes

involved in detoxification and dopamine regulation were shown to modulate the susceptibility to Parkinson's disease and could be important risk factors in the pathogenesis of this disease.

- PCR protocols were developed for the detection of the transgene (CRY1A(b) in GM Maize (MON 810) and RR Soya, which can be applied for the detection of transgenes that are present in the genetically modified food products.

- Tumor initiating potential of Aflatoxin B_1, a fungal metabolite that is present as contaminant in various food stuffs was shown in mouse skin model of carcinogenesis.

- Chemical analysis of Repeated Fish Fried Oil (RFFO) showed presence of various carcinogenic polycyclic aromatic hydrocarbons. RFFO was found to induce hepatic cytochrome p-450, benzo(a)pyrene and DNA binding and apoptosis.

- Silymarin, a herbal antioxidant, showed hepatoprotective effects against hepatotoxicity that was induced by selected drugs (rifampicin, pyrogallol) in mouse liver.

- The polyphenolic constituents of the most commonly consumed beverage, green and black tea, were found to induce apoptosis through Bax translocation, cytochrome c release and caspase activation in mouse skin tumors.

- Black tea polyphenols (BTP) were found to induce G2/M phase arrest of human prostate cancer cells (PC-3) initially. These at later stages induced apoptosis by modulating cell-growth regulators ($p21^{waf1/cip1}$, cdc25Ccyclin B). BTP also induces uptake of anticancer drugs in drug resistant human leukemic cell line (K562 cells).

- The plant alkaloid 'piperine' was found to mediated immunomodulatory efficacy on cadmium exposed murine splenocytes and thymocytes, exhibiting its role as an effective drug for Cd-induced immunotoxicity.

- Water quality variables and major classes of contaminants in samples collected from shallow and deep aquifers from Kanpur city were estimated by modeling based regional mapping. This revealed that both shallow and deeper aquifers in industrial areas are considerably contaminated with various chemical contaminants.

- A rapid and sensitive monitoring technology, Molecular Beacon, a Real Time Polymerase Chain Reaction (PCR) was developed for pre-emptive monitoring, water quality management, and detection of enterotoxicogenic *Escherichia coli* in water resources.

- A novel technique for decolorisation and detoxification of poor methanated distillery effluent (PMDE) was developed using pilot scale reconstructed wetland system to ensure environmental safety with minimal risk of pollution.

- Low dose prenatal exposure to lindane, an organochlorine insecticide , which does not induce any systemic effects in adult rats, showed the potential to produce overexpression of xenobiotic metabolizing CYPs in brain and liver of the offspring which may account for behavioral changes observed in the offspring.

- A new model of Indian earthworm (*Metaphire posthuma)*, towards acute toxicity testing of xenobiotics was developed.

ITRC undertook various societal programs for educating school/college students through lectures, demonstrations, film shows and exhibitions. We continued our support to our two adopted schools by providing scientific instruments and other necessary facilities to promote scientific temper in the students. ITRC also continued 'market basket survey' in various parts of the country, to monitor adulteration/contamination in food stuffs.

A number of scientists of the Centre received various awards and honors at different platforms. Research fellows and project assistants also participated in various national and international conferences and received prizes.

During this period, 127 research papers were published in peer reviewed journals along with 7 book chapters and 7 monographs. The average Impact factor per paper was 1.88. Six research fellows were awarded Ph. D. degrees during this period.

I acknowledge the contributions made by our staff in success achieved by the centre during the year and looking forward to their greater involvement and efforts in collective endeavor to become a globally competitive institute in toxicology research.

I must admit that none of the above would have become possible without the generous support of Director General, CSIR, various government and non-governmental agencies and Directors of other R&D organizations including CSIR laboratories. I would also like to thank Prof. M.S. Valiathan, Chairman and Members of our Research Council for providing their able guidance for the development of our institute.

I assure you that ITRC will continue to live to the nation's expectation by fulfilling the elements of our motto ***"Safety to environment and health and service to industry.***

Thank you

Ashwani Kumar

Ashwani Kumar

R & D Highlights

ITRC

Organisational Chart

- Research Planning & Business Development
- Toxicology Information Centre & Library
- Bioinformatics
- Quality Assurance Unit
- Computer Cell
- Instruments Service & Maintenance
- Biomedical Illustration & Photography

- Animal House
- Analysis of Pollutants
- Water Quality Analysis
- Environmental Impact Assessment
- Specialized Toxicity Tests
- Safety Evaluation of Chemicals & Products
- Regulatory Toxicology
- Toxicology Database
- Human Resource Development

R & D Areas

SYSTEMS TOXICOLOGY & RISK ASSESSMENT

ENVIRONMENTAL TOXICOLOGY

TOXICOGENOMICS & PREDICTIVE TOXICOLOGY

FOOD, DRUG & CHEMICAL TOXICOLOGY

The Motto :
Safety to environment
and health
&
service to industry

ASSESSMENT, MAPPING & REMEDIATION OF GROUND WATER CONTAMINATION

NATIONAL S & T MISSIONS

Genetic polymorphism in Indian population and its role in differential toxic response/susceptibility to diseases

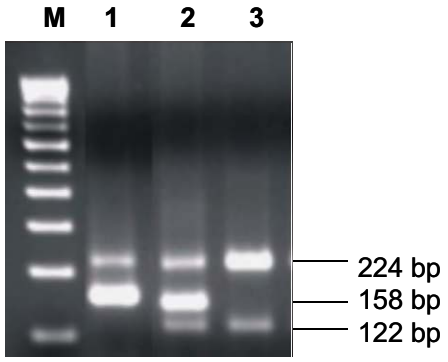
Role of microsomal epoxide hydrolase gene polymorphisms in lung/l.c. cancer: a multicentric case-control study in north Indian population

Microsomal epoxide hydrolase (EPHX1) catalyzes hydrolysis of carcinogenic epoxides into benign diols. Its activity, therefore, may be an important determinant for the risk of lung cancer. Polymorphisms in EPHX1 exonic regions of 175 newly diagnosed lung cancer patients and 322 case controls in north Indian population was determined by 'restriction fragment length polymorphism' and 'nucleotide sequencing'. Fourteen polymorphisms were observed. Binary logistic regression analysis of various polymorphisms revealed that a synonymous polymorphism Lys119Lys (G>A) is associated with low risk of lung cancer [adjusted odds ratio (OR) = 0.38, 95% confidence interval (CI) = 0.15-0.93, P=0.03]. Further, it was substantially more pronounced in younger ($\leq$52) subjects (adjusted OR=0.12, 95%CI=0.01-0.80, P=0.01). Separately, a non-synonymous polymorphism Tyr113His was found to be associated with increased risk of lung cancer (adjusted OR=2.2, 95%CI=1.2-4.0, P=0.01). Though, the reported tight linkage-disequilibrium between 113 and 119 loci was observed. However, no association of various predicted 'EPHX1 activity genotypes' with lung cancer was found in this study. This first comprehensive study in north Indian population shows an association of EPHX1-polymorphisms with lung cancer susceptibility.

Association of single nucleotide polymorphism in tumor suppressor (p53) and murine double minute-2 (MDM-2) genes with breast cancer risk in Indian women

Single nucleotide polymorphism (SNP) at position -309 (T309G) in MDM-2 promoter induces tumor formation in the individuals possessing inherited p53 mutations. The present study was undertaken to investigate the association of MDM-2 SNP309, p53 Arg72Pro and p53 intron-6 G/A polymorphism with total, pre-menopausal and post-menopausal breast cancer risks in Indian women. Genotyping of MDM-2 SNP309, p53 Arg72Pro and p53 intron-6 G/A in 104 patients and 105 controls was performed either by ARMS-PCR or by PCR and direct sequencing. The p53 Arg72Pro heterozygous variant and in combination with its homozygous variant exhibited a significant protective association with total [OR (95% CI): 0.42 (0.22-0.81) and 0.46 (0.25-0.85), p-value; 0.007 and 0.012] and postmenopausal breast cancer risk [OR (95% CI): 0.25(0.07-0.73) and 0.27(0.08-0.77), p-value; 0.009 and 0.013]. Neither combined nor homozygous/heterozygous MDM-2 SNP309G was associated with total, pre-menopausal or post-menopausal breast cancer risk. However, MDM-2 SNP309G along with p53 Arg72Pro heterozygous variant showed a significant protective association with pre-menopausal breast cancer risk [OR (95% CI): 0.18(0.02-1.20), p-value; 0.041 for homozygous + heterozygous MDM-2 SNP309G]. The results indicate protective associations of p53 Arg72Pro

heterozygous variant with post-menopausal and MDM-2 SNP309G along with p53 Arg72Pro heterozygous variant with pre-menopausal breast cancer risk.



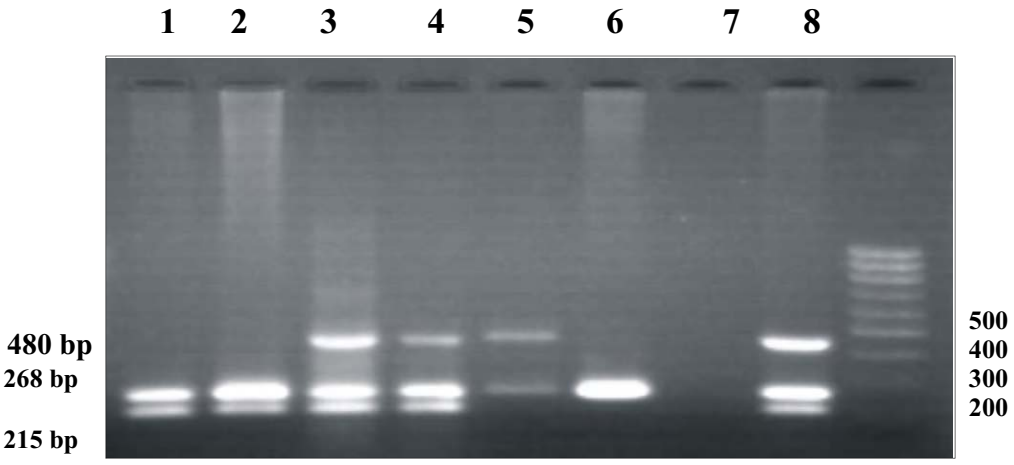
ARMS-PCR pattern of MDM2 SNP309 amplicons. Lane M, 1, 2 and 3 represent 100bp DNA ladder, G/G, T/G and T/T genotypes

Assessment of SNPs in xenobiotic metabolising genes in Indian populations

Single Nucleotide polymophisms (SNPs) in the genes involved in xenobiotic metabolism and toxicity studies were initiated to validate SNPs, in the Indian population, identified earlier in representative DNA samples in the SNP Discovery Panel. 576 DNA samples of 24 different Indian populations identified on the pattern, distributed geographically and linguistically, were analysed. The validation done at IGIB, New Delhi revealed that majority of the SNPs identified in the SNP Discovery Panel and those reported earlier in Causcasians and other European populations were found to be polymorphic in the Indian populations. SNPs identified in cytochrome P450 2D6, which lead to the poor metabolizer status (C/T: rs 16947, C/T: rs1065852, C/T: rs1081003) were found to be polymorphic in the studied population. Likewise, the functionally important polymorphisms in the genes involved in carcinogen metabolism i.e CYP1A1 (C/A: rs1799814, A/G: rs1048943, both present in exon 7; T/C: rs4646903 in 3'UTR), CYP1B1 (C/G: rs10012, G/T:rs10916 in exon 2: C/G: rs1056836, A/G: rs1800440, A/G: rs2855658, C/T: rs9341266 in exon 3), CYP1A2 (T/G: rs2069526, A/C: rs762551 present in intron 1, G/C: rs3743484 in intron 4), aryl hydrocarbon receptor, Ahr (G/A: rs2066853 in exon 10), aryl hydrocarbon nuclear translocator, Arnt (G/A: rs7517566 in 5' UTR, C/G: rs2228099 in exon 7 and A/G: rs11552229 in exon 22), CYP2E1 (A/G: rs3813870 in 5' UTR, G/T: rs2864984, T/A: rs 6413432 and G/A: rs 8192775 in intron 6) were also found to be polymorphic in Indian population. SNPs in the genes, involved in dopamine neurotransmission i.e. dopamine receptor 2, (DRD2), dopamine transporter (DAT), reported in other populations were found to be polymorphic in Indian population. Interestingly, some of the SNP positions found to be novel in representative DNA samples in SNP Discovery Panel CYP1A1 (C/T243 in exon2), CYP1B1 (5404T/G in exon 3), CYP1A2 (42C/T in exon2), Ahr (11033T/C in intron 2) were polymorphic in our population while some reported to be novel such as CYP2D6 (2526T/A in intron 4, 2967C/T in exon 6) were not found to be polymorphic in our population. Studies are in progress to analyze the data obtained from the validation panel in the other genes involved in xenobiotic metabolism and toxicity and also to determine the frequency of the alleles in Indian populations.

Genetic polymorphism in glutathione-S-transferases and its association with chronic myeloid leukemia

Inter-individual differences in susceptibility to hematological malignancies may be mediated in part through polymorphic variability in the bioactivation & detoxification of carcinogens. The glutathione-S-transferases (GSTs) have been implicated as susceptibility genes in the context. Multiplex PCR was carried out to determine the presence or absence of GSTM1 & GSTT1 gene and PCR-RFLP analysis for GSTP1 to determine Ile 105 Val polymorphism. The relationship between GSTM1, GSTT1 & GSTP1 and risk to cancer was assessed by means of logistic regression. The frequency of GSTT1 null genotypes was found to be statistically significant, and suggested that heritable GST status may influence the risk of developing chronic myeloid leukemia (CML).



Agarose gel demonstrating multiplex PCR genotyping of genomic DNA samples for detection of GSTM1 & GSTT1 gene deletion (null genotype).The absence of 480 bp band indicates GSTT1 null genotype; absence of 215 bp band indicates GSTM1 null genotype; β- globin was coamplified (268bp) in all samples. ***LANE 1,2****- GSTT1 null genotype ,* ***LANE 3,4,8*** *GSTM1 & GSTT1 positive genotype,* ***LANE 5*** *GSTM1 null genotype,* ***LANE 6*** *GSTM1 &GSTT1 null genotype,* ***LANE 7*** *Negative control,*
M *Marker 100 base pair DNA ladder.*

Polymorphism in environment responsive genes and association with Parkinson's disease

Attempts were made to investigate the role of polymorphism in the genes encoding proteins involved in toxication-detoxication pathways and dopamine regulation in enhancing susceptibility to Parkinson's disease (PD). In a case-control study seventy patients suffering from PD and one hundred healthy controls belonging to the same geographical location and same ethnicity were included in the study. PCR-RFLP and allele-specific PCR based methodology were used to identify the genotypes. Multivariate logistic regression analysis revealed that heterozygous genotypes of cytochrome P4502D6*4(CYP2D6*4), CYP2E1*5B (RsaI) polymorphism and homozygous mutant genotypes of CYP2E1*6 (Dra1) were found to be overrepresented in PD cases when compared to the controls. Risk was also found to be increased in patients carrying glutathione S-transferase T1 (GSTT1) null or homozygous variant genotypes of GSTP1. Significant association was observed for monoamine oxidase-B(MAO-B) variant allele G and PD, whereas no difference

in genotype and allele frequencies was observed for manganese-superoxide dismutase (MnSOD), dopamine receptor-D2(DRD2) and dopamine transporter (DAT) genes between controls and PD cases. Genotype combinations characterized by presence of two variant genotypes on their corresponding locus revealed that four combinations of GSTT1 null and MnSOD (-9Val) or GST null and MAOB-G or CYP2E1*5B and MAO-B-AG or CYP2E1*5B and DRD2 (Taq1A-het) genotypes in the patients exhibited several fold higher and significant association with risk to PD. Our data led us to suggest that polymorphism in the genes involved in detoxification and dopamine regulation may modulate the susceptibility to PD and could be important risk factors in the pathogenesis of PD.

Genetic polymorphisms in cytochrome P4501B1 and susceptibility to head and neck cancer

Cytochrome P4501B1 (*CYP1B1*), a polycyclic aromatic hydrocarbon (PAH) metabolizing CYP, is genetically polymorphic in humans and may be involved in the individual's susceptibility to chemical induced cancer. In the present study, genotype and haplotype frequencies of four single nucleotide polymorphisms (SNPs) in *CYP1B1* that cause amino acid changes (Arg-Gly at codon 48, Ala-Ser at codon 119, Leu-Val at codon 432 and Asn-Ser at codon 453) were studied in 150 patients suffering from head and neck squamous cell carcinoma (HNSCC) and in an equal number of controls. A significant difference was observed for the distribution of variant genotypes of Arg48Gly (*CYP1B1**2) and Ala119Ser (*CYP1B1**2) polymorphisms of *CYP1B1* in patients versus controls. No significant differences were observed for the distribution of variant genotypes Leu432Val (*CYP1B1**3) and Asn453Ser (*CYP1B1**4), respectively. When the four SNPs were analyzed using a haplotype approach, SNPs at codon 48 (Arg48Gly) and codon 119 (Ala119Ser) exhibited complete linkage disequilibrium (LD) in all the patients and controls. Significant differences in the distribution of the two haplotypes (G-T-C-A and G-T-G-A) were observed both in the patients and in controls. Furthermore, our data indicates a several fold increase in risk in the patients who use tobacco (cigarette smoking or tobacco chewing) or alcohol with the variant genotypes of *CYP1B1* (*CYP1B1**2 and *CYP1B1**3) suggesting the role of gene-environment interaction in the susceptibility to head and neck squamous cell carcinoma.

Association of genetic polymorphisms in glutathione-S-transferases and susceptibility to head and neck cancer

Polymorphism in glutathione S-transferase (*GST*) genes (*GSTM1, GSTT1 & GSTP1*) and interaction with environmental factors such as tobacco (smoking or chewing) and alcohol on susceptibility to head and neck squamous cell carcinoma (HNSCC) was studied in a case-control study. The study group consisted of 175 patients suffering from HNSCC and 200 age matched healthy controls. Statistical analysis showed an increase in risk to HNSCC in the patients with null genotype of *GSTM1* (OR: 2.02; 95%CI: 1.32-3.10; P=0.001) or *GSTT1* (OR: 1.66; 95%CI: 1.02-2.69; P=0.04), though the risk was not found to be significant when adjusted for age, sex, smoking, tobacco chewing or alcohol use by multivariate logistic regression model. Our data further showed that combination of deletion genotypes of GST

(GSTM1 and GSTT1) confer an even higher risk of HNSCC. Interestingly, *GSTP1* wild type genotype in combination with *GSTM1* null or *GSTT1* null genotype increased susceptibility to HNSCC (OR: 2.49 and 2.75 respectively). Likewise, a much greater risk to HNSCC was observed in the patients carrying a genotype combination of *GSTM1* null, *GSTT1* null and *GSTP1* (*Ile/Ile*) (OR: 4.47; 95%CI: 1.62-12.31; P=0.002). Our data have further provided evidence that tobacco chewing and alcohol consumption are the important risk factors to HNSCC. The interaction between tobacco chewing and null genotype of *GSTM1* or *GSTT1* resulted in about 3.5 and 2.2 fold increase in the risk respectively in the patients when compared to those not chewing tobacco. Alcohol use resulted in more than 4-fold increase in the risk in patients with null genotype of *GSTM1* as compared to those who are non-drinkers. Alcohol consumption also increased the risk (approx. 3 fold) in the cases with null genotype of *GSTT1*, though the association was not found to be significant when compared to non-drinkers. Our data have provided evidence that GST polymorphism modifies the susceptibility to HNSCC and have further demonstrated importance of gene- environment interaction in modulating the risk to HNSCC.

Animal models and animal substitute technologies for risk assessment

Comet assay in human peripheral blood lymphocytes: DNA damage induced by industrial solid waste and municipal sludge leachates

Exposure to toxic compounds occurs mostly in the form of complex mixtures. Leachates, consisting of mixtures of many chemicals, are a potential risk to human health. Leachates of solid wastes from a polyfiber factory, (PFL) an aeronautical plant (AEL), and a municipal sludge leachate (MSL) were assessed for their ability to induce DNA damage in human peripheral blood lymphocytes using the alkaline Comet assay. The leachates were examined for physical and chemical properties. Lymphocytes were incubated with 0.5% and 15.0% concentrations of the test leachates for 3 hr at 37^0C, and then treated with 1 mM ethyl methanesulfonate (a known mutagen). All the three leachates induced significant ($P < 0.05$), concentration-dependent increases in DNA damage as measured by increases in Olive tail moment, tail DNA (%), and tail length (μm). A comparison of these variables among the treatment groups indicated that the MSL induced maximum DNA damage as compared to other leachates as assessed by comet assay. Results indicate that the ever-increasing amounts of leachates from waste landfill sites have the potential to induce DNA damage and suggest that the exposure of human populations to these leachates may lead to adverse health effects.

Stable colloidal dispersions of C_{60} fullerenes in water: evidence for genotoxicity

Stable aqueous suspensions of colloidal C_{60} fullerenes free of toxic organic solvents were prepared by two methods: ethanol to water solvent exchange (EtOH/nC$_{60}$ suspensions) and extended mixing in water (aqu/nC$_{60}$ suspensions). The extended mixing method resulted in the formation of larger (≈ 178 nm) and less negatively charged (≈ - 13.5 mV) nC$_{60}$ colloids than nC$_{60}$ prepared by ethanol to water solvent exchange (≈ 122 nm, ≈ - 31.6 mV). Genotoxicity of these suspensions was evaluated with respect to human lymphocytes using single cell gel electrophoresis assay (Comet assay). The assay demonstrated genotoxicity for both types of suspensions with a strong correlation between the genotoxic response and nC$_{60}$ concentration, and with genotoxicity observed at concentrations as low as 2.2 μg/L for aqu/nC$_{60}$ and 4.2 μg/L for EtOH/nC$_{60}$. The Olive Tail Moments (OTM) for these two concentrations were 1.54 ± 0.24 and 1.34 ± 0.07 respectively, which in comparison to the negative control OTM of 0.98 ± 0.17 is statistically different with a p value of at least 0.05. Aqu/nC$_{60}$ suspensions elicited higher genotoxic response than EthOH/nC$_{60}$ for the same nC$_{60}$ concentration. The results represent the first genotoxicity data for colloidal fullerenes produced by simple mixing in water.

Establishment and validation of *in vitro* model for environmental xenobiotic induced immunotoxicity

Earlier studies on oxidative stress and apoptosis induced by cadmium (Cd) in lymphocytes *in vitro* and *in vivo* prompted us to study the effect of this heavy metal on lymphocyte subsets and cytokine secretion as a measure of immunotoxicity. BALB/c mice were treated with Cd as $CdCl_2$ (1.8 mg/kg,i.p) and splenic and thymic sub populations were determined at 24, 48 and 72 h along with the release of IL-2 and IFN- in ConA stimulated lymphocytes. *In vitro*, the cells were exposed to Cd (10, 25 and 50μM) and the above parameters were monitored at 18 h. Depletion of $CD4^+$ and simultaneous increase in $CD8^+$ cells resulting in the lowered $CD4^+/CD8^+$ ratio was recorded. Substantially decreased CD3 and CD19 cell population in spleen along with significant inhibition in IL-2 and IFN- release under both experimental conditions were observed. The comparable influence of Cd on the above indices suggests a similar mechanism of action and detailed explorative *in vitro* studies may be extrapolated to those occurring *in vivo*.

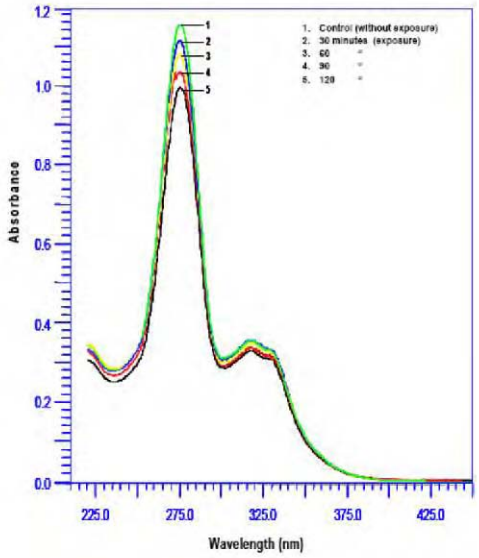
Establishment and validation of *in vitro* test model for gastrointestinal toxicity using intestinal epithelial cell

In vitro effect of aspirin (acetyl salicylic acid-sodium salt; 05.0 mg/ml) on immortal epithelial cell line (IEC-6) was evaluated. Results revealed significant decrease in IEC-6 cell membrane alkaline phosphatase (38%) and Ca^{2+}-Mg^{2+}-ATPase (65%) activities at the highest tested concentration of aspirin. While a significant dose-dependent decline (ranging from 15%-50%) in membrane structural constituents viz. hexose, sialic acid and cholesterol were evident, no change in membrane phospholipids contents were observed. More or less similar *in situ* effects of aspirin exposure following rat intestinal loop incubation on membrane enzymes and constituents of the intestinal epithelial cells validated the *in vitro* IEC-6 findings.

Photosensitizing potential of Ciprofloxacin at ambient level of UV-radiation

Phototoxicity assessment of ciprofloxacin, an antibacterial drug was studied in mouse fibroblast cell lines L-929 and NIH-3T3. Generation of reactive oxygen species (ROS) viz. singlet oxygen ($^1O_2$), superoxide anion radical ($O_2^{\cdot-}$) and hydroxyl radical ($^{\cdot}OH$) were studied under the exposure of ambient intensities of UV-A (1.14, 1.6 and 2.2 mW/cm^2), UV-B (0.6, 0.9 and 1.2 mW/cm^2) and sunlight (60 min.). The drug was found to generate $^1O_2$, $O_2^{\cdot-}$ and $^{\cdot}OH$ in a concentration and dose-dependent manner. Sodium azide (NaN_3) and 1,4-diazabicyclo 2-2-2-octane (DABCO) inhibited the generation of $^1O_2$. Superoxide dismutase (SOD) inhibited 90-95% $O_2^{\cdot-}$ generation. The drug (5-40 μg/ml) was responsible for linoleic acid peroxidation. Quenching study of linoleic acid peroxidation with SOD (25 and 50 units/ml) confirmed the involvement of ROS in drug induced lipid peroxidation. The generation of $^{\cdot}OH$ radical was further confirmed by using specific quenchers of $^{\cdot}OH$ like mannitol (0.5 M) and sodium benzoate (0.5 M). 2′-deoxyguanosine (2′-dGuO) assay and linoleic acid peroxidation showed that ROS were mainly responsible for

ciprofloxacin-sensitized photo-degradation of guanine base. L-929 cells showed 29, 34 and 54% reduced cell viability at higher drug concentration (300 µg/ml) under UV-A, UV-B and sunlight, respectively. MTT assay in NIH-3T3 cells at higher drug concentration (300 µg/ml) showed a decrease in cell viability by 54, 56 and 59% under UV-A, UV-B and sunlight, respectively. Results of neutral red uptake assay (NRU) in L-929 cell line were comparable to MTT assay. The NIH-3T3 cells showed a higher photosensitizing potential than L-929. Ciprofloxacin was observed to produce ROS by Type I and Type II photodynamic reactions, interacted with nucleic acid moiety and inhibited cell viability. Further, UV-induced photo-peroxidation of linoleic acid indicated the involvement of ROS in the manifestation of drug phototoxicity. Appearance of ciprofloxacin induced phototoxicity at the ambient level of sunlight warrants avoidance of exposure to sunlight during this antibiotic treatment.



Degradation spectra of ciprofloxacin at different time intervals

Phototoxic potential of anti-diabetic drugs

Phototoxic potential of two anti-diabetic drugs glipizide and glybenclamide was assessed by studying *in vitro* photogeneration of reactive oxygen species (ROS), singlet oxygen and superoxide radical on exposure to ambient levels of UV-A (2.0 mW/cm^2), UV-B (0.5 mW/cm^2) in sunlight and sunlight (1200 K lux). The drugs did not show ROS generation under dark conditions, however on exposure to UV-A, UV-B and sunlight, both the drugs (25, 50, 70 and 100 ppm) showed concentration dependent ROS generation. Glipizide showed comparatively more ROS generation than glybenclamide.

Establishment of A-431 cell line for phototoxicity assessment of fluoroquinolones

A-431 cells were grown in DMEM F-12 medium supplemented with 10% fetal bovine serum, 2% Na_2CO_3 and 1-2% antibiotic antimycotic solution.

Fluoroquinolones drugs such as enoxacin, ofloxacin, lomefloxacin and norfloxacin were assessed for their phototoxicity using the above cells. The results showed 30-70% cell viability at 100 ppm drug concentration under UV-A (1.5 mW/cm^2), UV-B (0.6 mW/cm^2) and sunlight (1200 K Lux) exposure.

Phototoxicity assessment of distillery effluent by using *Spirodela polyrhiza*

Duckweed (*Spirodela polyrhiza*) was used for the phototoxicity assessment of industrial waste water generated from distillery, paper, pesticide manufacturing units and tannery industries. UV-A induced phototoxicity of distillery waste water was observed in duckweed both in dark and light conditions. Visible symptom was chlorosis which began appearing at 5% concentration. The browning of fronds increased in a dose-dependent manner. At 40.0, 80.0 and 100.0 % concentrations of waste, all the fronds became totally brown at 24 and 48 h of exposure both in dark and light conditions. Comparative observation of paper industry effluent and UV-A induced phototoxicity on duckweed showed no visible symptoms up to 10.0% concentration in all the groups exposed at 24 h, 48 h, both in dark and light conditions. Further, 80.0 % and above concentrations were lethal in all the groups. Effluent from pesticide industry had no visible effect upto 22.5% concentration both at 24 and 48 h of exposure. However, at 33.75 % concentration, slight necrosis was observed in duckweed fronds in light condition only. At 100.0 % concentration all the 10 fronds became totally brown and dead. Tannery effluent revealed no visible symptom in control group both in dark and light conditions during 24 and 48 h of exposure. Visible mild symptoms were observed at 20.0 % concentrations under dark condition, both after 24 and 48 h of exposure; while in light condition, very severe and lethal symptoms were observed. However, 40.0 and 50.0 percent concentrations were found to be lethal both in dark and light conditions after 24 and 48 h of exposure.

Developmental toxicity of poultry litter leachate (PLL) to a fresh water pond snail *Lymnaea luteola*

A representative sample of poultry litter (approximately 3 kg) was collected arbitrarily from local broiler poultry farmhouse manually, using sterilized gloves and plastic bags. The samples were air dried at 110 $^{\circ}$C for 6 h, homogenized and sieved (2mm). For PLL preparation, 1 g poultry litter was mixed with 100 ml deionized water. The mixture was agitated on a rotary shaker at 200 rpm. At the end of 1 and 7 days, the mixture was centrifuged and supernatant filtered. The PLL thus obtained was separated and toxicity determined. It was observed that PLL significantly increased hatching time of *Lymnaea luteola,* whereas their hatching numbers drastically decreased during 15 days of exposure. Other parameters such as growth, survival of larval stages, shell, foot, eyes, and shell gland formation were recorded. Trochophore, veliger and velichoncha larval stages period was extended. The EC_{50} values, their 95 percent confidence limits, and percentage of mortality at different PLL concentrations were determined. Addition of clay at 0.5 and 1g / 100 ml of PLL significantly reduced toxicity to the snail embryo with respect to survival and other developmental abnormalities.

Evaluation of the presence of low doses of toxicants in food, water and soil using transgenic Drosophila strains that harbour chromogenic gene markers under the control of stress promoters

The status of stress gene family members as a measure of cellular toxicity along with hsp70 *Drosophila melanogaster* strains transgenic for hsp83 (hsp90), hsp26 and hsp 27 were used to examine their expression after exposure to leachates of four municipal solid wastes. Reporter gene assay for measuring β-galactosidase activity was carried out and also the resident gene expression by RT-PCR. Of the four municipal solid waste leachates, that of the sample 3 evoked maximum induction of hsp70 followed by hsp26, hsp27 and hsp83 in the exposed larvae. While hsp70 was found to be significantly induced as early as 6 h; hsp26 and hsp27 were significantly induced after 12 h and hsp83 only after 18 h of exposure to the said leachate respectively. Real time PCR (qPCR) studies also confirmed a similar trend in the induction of the different stress genes in the exposed organism. The study suggests that reporter gene assay in transgenic Drosophila offers amenable way to detect low concentrations of toxicants present in complex chemical mixtures both qualitatively and quantitatively in the exposed organism.

Validation of test systems to evaluate xenoestrogenic potential of environmental chemicals

To elaborate studies for the detection of estrogenic potential of chemicals, an attempt was made to search for alternate cell lines along with MCF-7 cells. Indigenous dietary sources especially of plant origin known for their modulating female reproductive physiology, as evident by age-old practices in our country, were taken up for the study. Dry ginger and *Chenopodium album*, commonly known as Bathua, were evaluated using NIH3T3, and A431 skin cell lines and their estrogenic potential compared with already known MCF-7 cell line used so far for assessing estrogenicity.Various cytotoxic parameters like Trypan blue dye exclusion test, MTT and LDH levels were carried out followed by cell proliferation assay at different time intervals i.e. 24, 48, 72 h. The results suggest that the cell line NIH3T3 is not responsive at tested doses when compared to controls. The cell line A431 represents only 10% estrogenic responsiveness in comparison to control groups during the Chenopodium treatment (1.0 and 5.0%). The MCF-7 cell lines showed the highest proliferation in both the test products.

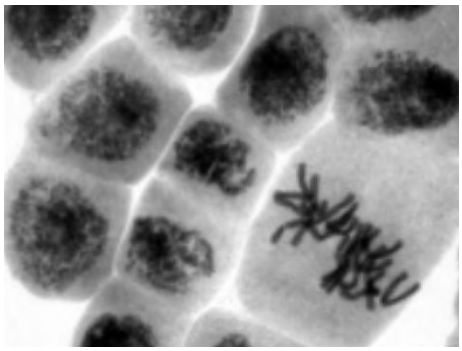
Validation of Indian earthworms for acute toxicity test

Studies were conducted to validate the sensitivity of Indian earthworm *Metaphire posthuma*, towards acute toxicity testing. Carbaryl, a carbamate insecticide, was tested on *M.posthuma* and *Eisenia foetida* in order to generate comparative toxicity data profile. Various concentrations of carbaryl (2, 4, 8, 16 and 32 ppm) were used and the acute toxicity was observed by filter paper contact method. During 72 h of exposure, LC_{50} for *M.posthuma* and *E.foetida* were found to be 8.57 ppm and 11.06 ppm respectively. Mid-segmental swellings and bleeding sores were also observed as morphological abnormalities when exposed beyond 8 ppm. *M.posthuma* was observed to be more sensitive than *E.foetida.*

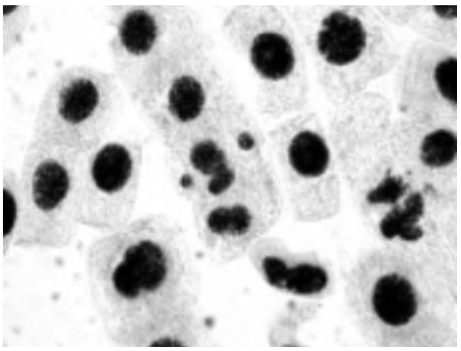
In another set of experiment, the same study was performed following the soil medium method using 2064 ppm Carbaryl for the study. LC_{50} values for *E. foetida* and *M. posthuma* were 18.37 ppm and 11.02 ppm, respectively, for 7 days exposure. Severe thinning and bleeding sores at post-clitellar region were also observed beyond 16 ppm of exposure. These data reaffirm better sensitivity of *M. posthuma* when compared with *E. foetida*. LC_{50} values of Fenvalerate, a synthetic pyrethroid insecticide for *M.posthuma* and *E. foetida* were 22.13 and 43.49 ppm respectively after 7 days of exposure.

Genotoxic effects of Chlorpyrifos and/ or Cypermethrin on the root meristem cells of *Allium cepa*

Cytogenetic studies were conducted to measure the genotoxic effects of chlorpyrifos and cypermethrin. Allium roots under growing conditions were exposed to EC_{50} values of Chlorpyrifos (Radar, 20% EC) and Cypermethrin (Cybill 25% EC) and their combination. EC_{50} values for chlorpyrifos, cypermethrin and mixture of both were determined at 7.2, 10 and 24.5 ppm respectively. The test concentrations were ascertained on the basis of active ingredient present in the



Normal root meristem cells of A. cepa



Micronucleus formation (Chlorpyrifos)

Normal anaphase cell of A. cepa (Chlorpyrifos)

Anaphase with lagging chromosome

mixture available in the market (Action 50% chlorpyrifos and 5% cypermethrin). Root meristem cells of *Allium cepa* were exposed to 5.25, 10.5 or 21 ppm of chlorpyrifos or 0.5, 1.0 or 2.0 ppm of cypermethrin or 5.25+ 0.5, 10.5+1.0 or 21+2 ppm of chlorpyrifos + cypermethrin for 24 h and the cells were examined for mitotic index (MI), induction of mitotic aberrations and micronucleus formation. Independent exposure to chlorpyrifos significantly inhibited the MI and induced

frequency of mitotic aberration and micronucleated cells significantly ($p<0.001$), whereas treatment with cypermethrin failed to induce any effect on root meristem cells. In combined treatment, induction of mitotic aberrations and micronucleus formation was however significant but the frequencies were lower than that to induced by exposure to chlorpyrifos alone. The findings suggest that the exposure to chlorpyrifos can induce genotoxicity in plants however; the co-existence of these compounds antagonizes the genotoxicity.

Safety evaluation of newer anti-asthmatic & anti-allergic molecules/drugs

Toxicological/safety evaluation of newer anti-asthmatic & anti-allergic molecules/drugs and basic research on pulmonary diseases that may help in understanding the mechanism of pulmonary damage on one hand and identification of molecular markers for development of in vitro cellular model are being persued. Some findings are:

- Acute oral toxicity (LD_{50}) in rodent from IC_{50} was predicted by performing *in vitro* BALB/c 3T3 Neutral red Uptake (NRU) cytotoxicity test. Based on the 3T3 NRU regression model, log (LD_{50}) = 0.506 X log (IC_{50}) + 0.475, we predicted acute oral toxicity of 8 new drugs from Indian Institute of Chemical Biology, (IICB) Kolkata and Indian Institute of Chemical Technology, (IICT) Hyderabad (IICB-D6, IICT-TA-45, IICT-TA-49, IICT-TA67, IICT-TA52, IICT-TA55, IICT-TA71, IICT-TA83). The respective acute oral LD_{50} values are 1873, 423,318, 430, 825, > 1749, >993, 1561 mg/kg bw.

- Subchronic oral toxicity of an active compound IICB-14 C6 has been performed and NOAEL was found to be 23/kg bw

- Acute oral toxicity of IICT-TA67 (sample from IICT, Hyderabad) has been performed and was found to be safe at the limit dose.

Hyperexpression of Socs3 and low expression of Stat3 genes marks asthma in mice

Stat3, Socs3 and cytokines play an integral role in the coordination and persistence of inflammation. Stat3 is implicated in asthma pathogenesis; Socs3 evokes Th2 cytokines, IgE and eosinophilia favoring inflammation while cytokine like IL-6 upon binding to its receptor activates Stat proteins. A clear understanding of the role played by Stat3/IL-6 and Socs3 in asthmatic airways is lacking. In this study, we report the status of expression and activation of Stat3 by ovalbumin (OVA), in lung and establish its relationship with Socs3 and IL-6 in mouse with symptoms of asthma. Balb/c mouse was sensitized and challenged with OVA transformed organism with asthma phenotype (ast^{+}) characterized by specific resistance of airways (sRaw) >6 cmH2O.s and presence of 150.g/ml of OVA specific IgG antibody and 8.93.g/ml OVA specific IgE antibody in the bronchoalveolar lavage fluid (BALF). Saline sensitized and challenged Balb/c mice (ast^{-}) have sRaw~2.5 cmH2O.s and absence of OVA-specific IgG and IgE antibodies in the BALF. Basal

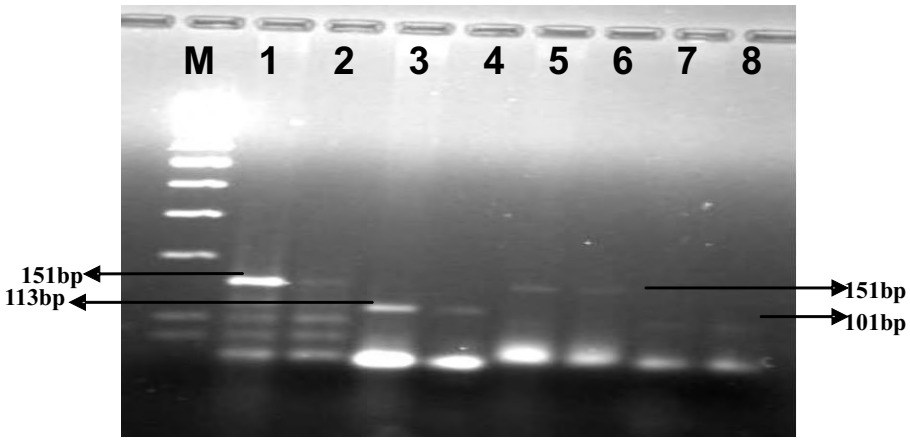
pool of Stat3 mRNA and protein in *ast*$^{-}$ mice was detected in the lung that was increased following OVA challenge. In contrast, expression and activation of Stat3 mRNA and protein respectively were found significantly low in lung of *ast*$^{+}$ mice in comparison to *ast*$^{-}$ mice following OVA challenge. Interestingly, higher pool of Socs3 mRNA was observed in *ast*$^{+}$ mice 24h post OVA challenge in comparison to *ast*$^{-}$ mice. Transient *in vivo* blocking of Stat3 gene expression by transfecting Stat3 siRNA 48h prior OVA challenge did not affect sRaw and lung volume in *ast*$^{+}$ mice while blocking Socs3 gene by Socs3 siRNA partially restore normal sRaw and expression of IL-6 protein in *ast*$^{+}$ mice. The results obtained demonstrate that underexpression of Stat3 gene is associated with over-expression of Socs3 gene and low level of IL-6 peptide in serum, and BALF in a mouse model of asthma. Socs3 may contribute to the negative regulation of Stat3 via IL-6 in OVA induced asthma in mice.

Detection and safety evaluation of GM foods/drugs

Application of standardized PCR protocols for detection of transgenes in GM food

In India, genetically modified foods/organisms are regulated under the purview of the 1986 Indian Environment (Protection) Act. These rules and regulations cover the areas of research as well as large-scale applications of GMO's and products, throughout the country involving use, import, export, storage and research. At present no GM food crop has been approved in Indian market except a feed crop Bt cotton. Indian Government is following a policy of case-by-case approval of transgenic crops.

The aim of the present study was to detect the transgene introduced in GM Maize (MON 810) and RR Soya to check whether there is any unwarranted entry of these GM food crops /food products in the country. For this purpose, PCR protocols for the detection of transgenes in different crops were developed. Protocols for real time PCR- based quantitation of transgenes and house keeping genes were also standardised. Briefly, few samples from the supermarkets of Lucknow and Delhi were collected, which had a tag of import samples to detect the transgenes Cry1A(b), epsps, 35 S promoter & NoS (nopaline synthase) terminator sequences along with the house keeping genes (starch synthase for maize and lectin for RR soy) by using standardised technique. Out of all the maize samples, 20% showed the presence of Cry1A (b) transgene in imported maize samples whereas, no epsps transgene could be detected in soya samples. The results obtained suggest that the developed protocols can be applied for the detection of transgenes that may be present in the food products.

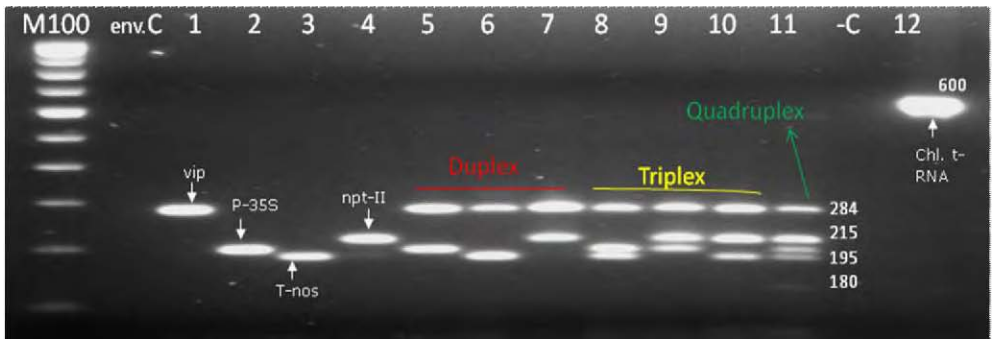


M - **Molecular weight Marker**
1&2- **Starch Synthase Housekeeping Gene**
3&4- **Transgene Cry1A(b)**
5&6- **Nopaline Synthase (NOS) Terminator**
7&8- **Ca MV 35S promoter**

PCR based detection of transgenes in market samples (Picture depicting products using SYBR Green based Real Time PCR)

Detection of novel recombinant *vip3* A insecticidal protein & gene in GMOs protein and DNA based assays

Vegetative insecticidal protein (Vip), a unique new class of insecticidal protein, is part of transgenic plants for conferring pest resistance. In order to address the regulatory need for detection and labeling of *vip3A* carrying GM products, a competitive ELISA with a detection sensitivity of 50 ng and a qualitative prototype Dipstick test has been developed. The study employed currently available *vip3A* transgenic cotton, tobacco and brinjal. For DNA based sensitive detection, standard single PCR & multiplex PCR assays were developed. To the best of our knowledge, this is the first report on PCR based detection of *vip3A* gene in any transgenic plant, produce or seed. Our standard assay involves amplification of 284 bp region of the *vip3A* gene. This assay can possibly, detect as many as 20 natural wild type isolates bearing *vip3A* like gene and two synthetic genes of *vip3A* in transgenic plants. The limit of detection, as established by our assay for GM trait (*vip3A*), is 0.1%. The three multiplex PCR assays (duplex, triplex & quadruplex) concurrently detect transgene, promoter, terminator and marker gene. An Indian patent # 1891/DEL2006 related to this study has been filed.



Standard & Multiplex PCR assays for vip3A gene (284bp), marker gene (215bp), promoter (195bp) & terminator (180bp) sequences of vip3A in GM Cotton leaf

Advanced facility for the safety evaluation of genetically modified/engineered drugs

In-vitro safety evaluation studies were conducted on rDNA-human insulin and rDNA-interferon alpha, selected as model GM-Drugs. Bovine pancreatic insulin was used as standard reference material, Tamoxifen as positive control substance for cytotoxicity and HepG2 cell lines in culture as test system. Under optimized conditions, the culture medium contained only 0.2% of fetal calf serum to prevent influence of inherent insulin in FCS that saturates the insulin receptors on the cells and masks the effect of test-insulin. Range finding studies on test-insulin (1.0ng/ml to 2µg/ml equivalent to 0.001 to 2 IU) showed optimal growth at 0.1µg/ml. Using this combination, the cell culture was monitored for viability, growth, mitochondrial oxidation and cytotoxicity through sulfrhodamine assay, protein content, MTT assay and DNA content. The results indicated comparative response of HepG2 cells to bovine pancreatic insulin and rDNA human insulin at equal concentrations. The test substances induced no toxicity in HepG2 cell-cultures while Tamoxifen exhibited

characteristic toxicity starting at 20µm and 100% cell death at 40µm concentrations. The rDNA human insulin was found to be 114-228 times safer than the recommended human dose. Similar experiments, conducted using 3000 to 37500 IU/ml of interferon alpha in HepG2 cell cultures revealed optimal response with 15000 IU/ml and a safety ratio of over 875 times higher than the recommended human dose. The observations of these experiments may have application in designing further studies and interpretation of observations/results on new molecules.

Toxicological implications of food adulterants/contaminants

Safety evaluation studies on argemone oil through dietary exposure for 90 days in rat

Epidemic dropsy is a disease caused by the consumption of mustard oil contaminated with argemone oil (AO). During 1998 dropsy in New Delhi, which is so far the largest with more than 3000 victims and over 60 deaths, the maximum tolerated dose of AO was not established. Hence, the present study was aimed to investigate the safety levels of AO in rats. Animals were given AO in diet at a dose of 0.001, 0.01, 0.1, 0.5 and 1% daily for 90 days and the two control groups received the standard diet with and without 1% mustard oil. A decrease in body weight gain (28-31%) was observed in 0.5 and 1% AO groups; while significant increase in relative lungs and liver weight was noticed in respective doses of 0.01% and 0.1% AO groups as well as in animals given the higher dosage. Reduction in RBC count and hemoglobin content ($p<0.05$) was noticed in 0.01% and 0.1% AO exposed animals. Serum marker enzymes including alanine transaminase (ALT), aspartate transaminase (AST), lactate dehydrogenase (LDH) and alkaline phosphatase (ALP) were found to be significantly elevated in 0.01 to 1% AO groups. Histopathological changes in lung were observed at 0.01% dose of AO while liver, kidney and heart produced changes at >0.1% AO doses. None of the parameters were found to be affected in 0.001% AO treated animals. These results suggest that the No Observed Adverse Effect Level (NOAEL) dose of AO is 0.001% in rats and considering a factor of 100 for humans for toxic compounds, the safe limit of 0.00001% (100 ppb or 100ng AO/g oil) AO can be implicated which shall contain only 0.55% of sanguinarine equivalent to 0.6ng sanguinarine per g oil. However, the minimum detectable limit of AO is 5 ppm (equivalent to 5 ug sanguinarine per g oil) with the present existing HPLC method, thereby suggesting that mustard oil should be absolutely free from AO contamination.

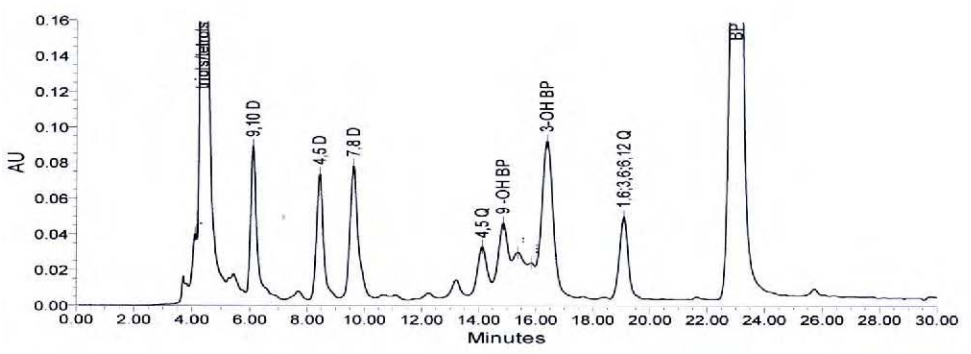
Skin tumorigenic potential of Aflatoxin B1 in mice

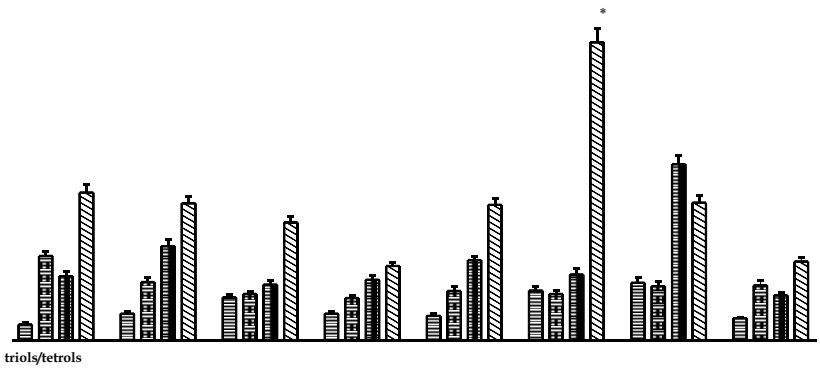
Aflatoxin B1 (AFB1) has been classified as category I human carcinogen, which is responsible for high incidences of hepatocellular carcinoma. Since, exposure to AFB1 can occur through skin contact in addition to ingestion and inhalation, carcinogenic potential of topically applied AFB1 on mouse skin was investigated. Single topical application of AFB1 (80nmol) followed by twice weekly application of 12-tetradecanoyl phorbol myristate acetate (TPA, 4 nmol) resulted in tumor formation after 13 weeks. However, no tumorigenic potential was observed when AFB1 (4nmol) was used as complete carcinogen or tumor promoter after dimethylbenzanthracene (120 n mol) application. Histological analysis of skin showed squamous cell carcinoma in AFB1/TPA treated group. AFB1 used either as complete carcinogen; initiator or promoter after 25 weeks demonstrated widespread degenerative and necrotic changes in hepatic tissue as well, suggesting toxic manifestation following percutaneous absorption. Additionally, twice weekly topical application of AFB1 (4 nmol) caused significant induction of glutathione-S-transferase activity in liver (68%) and skin (56%). AFB1 topical application also

resulted in increased hepatic and cutaneous lipid peroxidation and with concomitant depletion of glutathione content. It is likely that due to higher induction of hepatic GST activity the products of lipid peroxidation may not be able to cause DNA damage making mice resistant to hepatic tumor formation. The overall results imply tumor initiating potential of AFB1 in mice and suggest that continued dermal exposure to AFB1 even at low doses might lead to degenerative changes in hepatocytes but not hepatic adenomas.

Induction of hepatic cytochrome P450 isozymes, benzo(a)pyrene metabolism and DNA binding following exposure to polycyclic aromatic hydrocarbon residues generated during repeated fish fried oil in rats

In the present study, the effect of repeated fish fried oil (RFFO) and its extract (RFFE) on hepatic cytochrome P450 (CYP) isozymes, benzo(a)pyrene (BP) metabolism and DNA adduct formation was undertaken. HPLC analysis of RFFO showed the presence of several polycyclic aromatic hydrocarbons. CYP in microsomes from control and RFFO treated animals showed a peak at 450 nm,





however, a shift of 2nm in the SORET region along with significant induction was observed in microsomes prepared from 3-methylcholanthrene (MC) and RFFE treated animals. Immunoblot analysis revealed that RFFE and MC were potent inducers of CYP1A1, 1A1/2 and 3A1 isozymes, where as RFFO showed no change

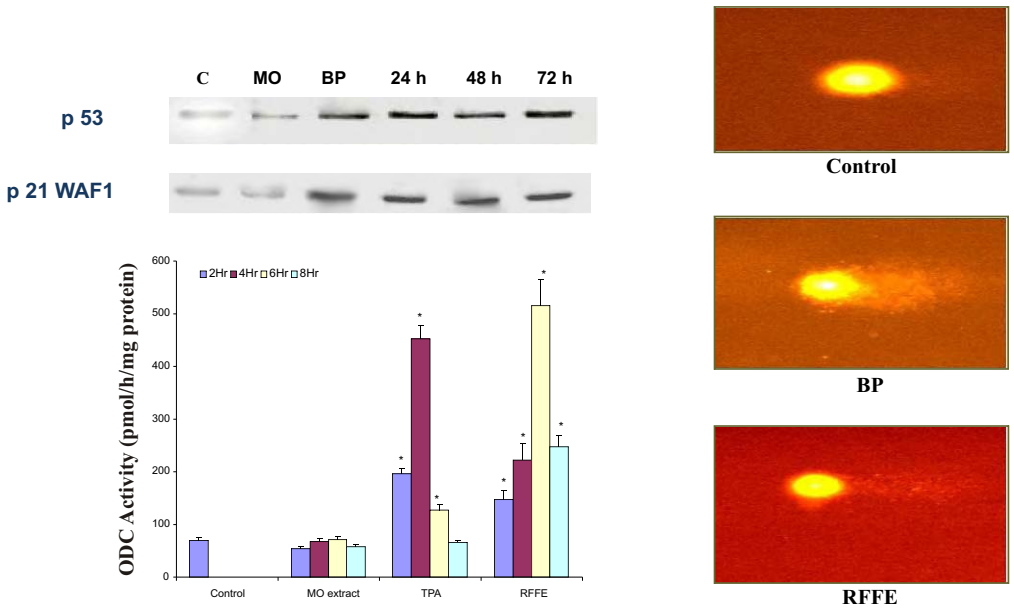
in these protein levels. RTPCR analysis showed induction of cDNA of CYP1A1 and CYP3A1 by RFFE treatment. Hepatic microsomes prepared from RFFE exposed animals enhanced BP metabolism with a concomitant increase in the relative proportion of BP 7,8-diol. Hepatic microsomes prepared from animals pre-treated with RFFE and MC significantly enhanced the binding of [^{3}H]-BP to calf thymus DNA. The overall results suggest that exposure to RFFE may induce hepatic CYP isozymes thereby producing enhanced reactive metabolites with a potential to bind with DNA which may result in cancer.

Induction of p^{53}, p21 waf1, oranithine decrboxylase activity and DNA damage leading to cell cycle arrest and apoptosis following topical application of repeated fish fried oil extract to mice

Repeated frying of food produces numerous carcinogens including polycyclic aromatic hydrocarbons (PAHs). Earlier studies have shown that repeated fish fried oil extract (RFFE) induces cytochrome P-450 1A1/2 isozymes thereby causing increased generation of electrophilic reactive metabolites of PAHs and subsequent binding to DNA. In the present study molecular events associated with DNA damage, apoptosis and proliferation following topical exposure to RFFE have been investigated in mice. Single topical application of RFFE (500 µg) for 24-48 hr caused significant DNA damage using Comet assay in terms of Olive tail moment (OTM) (204-246%), tail DNA (253-293%) and tail length (172-195%). Over expression of p53 and p21 WAF1 proteins was observed in skin cells following single topical exposure to RFFE for 24-72 hrs, which was similar to that of benzo(a)pyrene(BP) exposure(24 hr). Though RFFE and BP exposure separately, did not result in G0/G1 arrest, but a significant increase in the proportion of cells in S phase was observed. Apoptotic induction was noticed in skin cells, with maximum induction after 48 hr of exposure to RFFE. Further, topical treatment of mice with RFFE (500 µg) for 6 hrs significantly increased ornithine decarboxylase (ODC) activity by 7.5 fold when compared to control. These results indicate that RFFE exposure caused ODC induction accompanied by increased levels of p53 and p21WAF1 proteins leading to apoptosis and delay of cells in S phase thereby indicating a possible carcinogenic potential of RFFE.

Assessment of carcinogenic potential of repeated fish fried oil in mice

In the present study carcinogenic potential of repeated fish fried oil (RFFO) and repeated fish fried oil extract (RFFE) was assessed. Single topical application of RFFO (100 µl/animal) and RFFE (100-500 µg/animal) to Swiss albino female mice resulted in significant induction (1.8-7.4 fold) of ornithine decarboxylase activity. Twice weekly topical application of methylcholanthrene (MCA) for 24 weeks or single topical application of 7,12-dimethylbenzanthracene (DMBA) or RFFO or RFFE, as initiator followed by twice weekly application of 12-O tetradecanoyl phorbol myristate acetate (TPA) as promoter for 24 weeks, resulted in development of skin papillomas after 6, 7,18 and 9 weeks, respectively. The cumulative number of tumors in MCA, DMBA/TPA, RFFE (200 µg)/ TPA and RFFE (500 µg)/TPA groups were 276, 168, 34 and 58 after 24 weeks while negligible or minimal initiating



Cutaneous p53, p21WAF1 proteins, olive tail moment and ODC activity in RFFE exposed mice

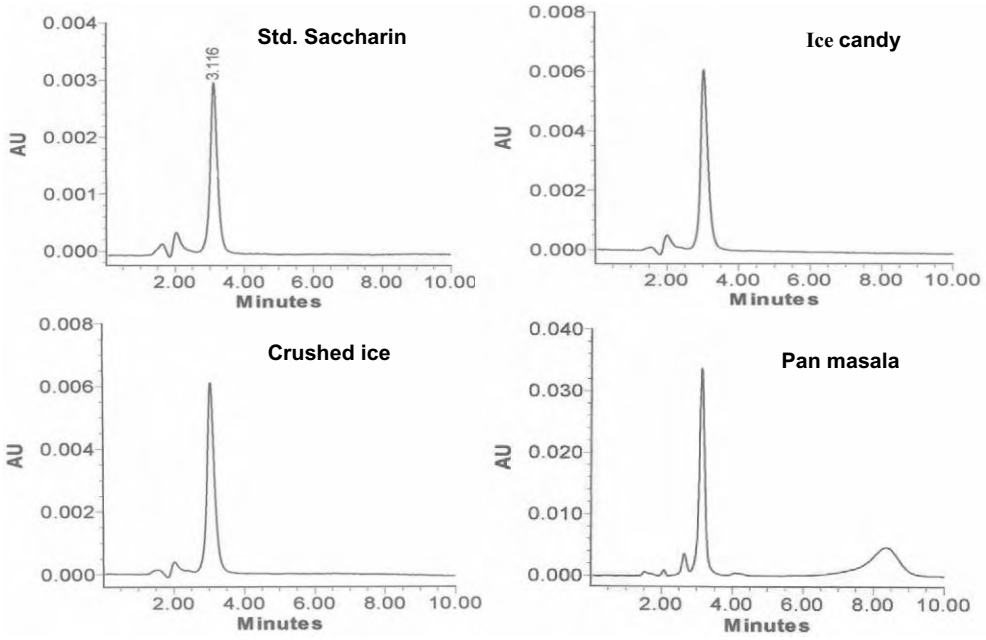
activity was noticed in RFFO/TPA group. No tumors were found in animals either given twice weekly topical application of RFFO or a single initiating dose of DMBA followed by twice weekly application of RFFO. Histopathology of skin of animals treated with RFFE/TPA showed marked proliferation of epidermal layers along with abnormal mitosis and multinucleated tumor appearance. Skin of animals in groups treated with RFFO/TPA and DMBA/RFFO showed sloughing and regeneration of epidermal layers, oedema along with proliferation of fibroblasts. Histochemical localization of γ-glutamyl transpeptidase was found to be substantially higher in skin of mice treated with RFFO/TPA and RFFE/TPA. These results suggest that RFFE possesses skin tumor initiating activity.

Development of heavy metal resistance in *Lactobacilli* strains for their efficacy in the prevention of GI-toxicity as probiotics

Arsenic (As) and chromium (Cr) ingestion through drinking water and food may lead to several diseases, inluding GI-disorders which are common environmental pollution related problems in several countries including India. Bacteria living within the intestinal lumen play an important role in host homoeostasis. *Lactobacilli* are known to provide specific health benefits as probiotics when consumed as a food component or supplement. In order to study the use of As and/or Cr-resistant *Lactobacilli* as probiotics against these heavy metal poisoning, resistance of As-III and Cr-VI were developed in mixed culture of *Lactobacillus* sp. (isolated from rat intestine) and three pure cultures (*L. acidophilus, L. rhamnosus and L. casei*) under *in vitro* conditions following chronological chronic exposures. Arsenite resistance up to 16 ppm and chromium resistance up to 64 ppm have been developed. Growth phase studies indicated significant similarities in growth pattern of As and Cr-resistant bacteria with that of respective normal bacteria. Further comparative studies of biochemical parameters such as membrane enzymes and constitutents, dehydrogenase and esterase activity tests are in progress.

Usage of saccharin in food products and its intake in the population of Lucknow

A survey study on the usage pattern of artificial sweetener, saccharin, in edible commodities followed by its intake pattern in different population groups was carried out. Of the different edible commodities, ice candy (87 numbers), crushed ice (14 numbers) commonly consumed by children and pan masala (16 numbers), pan flavourings (10 numbers) consumed by habitual populations were collected from different areas of Lucknow. Saccharin was extracted and analysed by HPLC. The consumption of ice candy and crushed ice was performed in household dietary



HPLC profile of saccharin extracted from different edible commodities

survey (414 families having 1039 subjects) of Lucknow population (6-20 years of age). The consumption of pan masala and pan was assessed by survey on adult habitual consumers comprising 782 and 1141 subjects, respectively. The average and maximum amounts of saccharin in pan masala samples was found to be 12750 and 24300 mg kg^{-1}, which is 1.6 and 3 fold higher than the maximum permitted levels allowed under Prevention of Food Adulteration (PFA) Act of India. In pan flavourings, the average and maximum amount of saccharin was 12.2 and 20.1% i.e. 1.52 and 2.5 fold higher than the permissible limits of PFA Act. The samples of ice candy and crushed ice showed an average and maximum levels of 200 and 700 mg kg^{-1} and 280 and 460 mg kg^{1}, respectively. The average intake of saccharin through ice-candy and crushed ice was well within the acceptable daily intake (ADI) (5 mg kg^{-1} bw day^{-1}), saturating it by less than 21%. However, maximum intake of saccharin, especially in 6-10 years age group, led to 57 and 68% saturation of ADI through ice-candy and crushed ice, respectively. Maximum consumption of saccharin in all the age groups, if consuming both ice-candy and crushed ice, saturated 154% of ADI in 6-10 year age group subjects. Hence the 6-10 year age group population may be at

risk of exceeding the ADI for saccharin. The average and maximum theoretical daily intake of saccharin through pan masala alone was 1.84 and 13.33 mg kg^{-1} bw day^{-1} saturating 37 and 267% of ADI whereas the estimated (maximum) daily intake was much higher saturating the ADI by 810%. Maximum amount of estimated daily intake (EDI) of saccharin through pan was 6.87 mg kg^{-1}bw day^{-1} saturating the ADI by 137%. Thus the populations where consumption of pan masala or pan is maximum are likely to be more susceptible to toxic effects of saccharin including bladder distention, osmolality of urine, bladder cancer.

Herbal bioactivity and safety assessment

Development of scientifically validated herbal health promoters

Positive Health Promoter (PHP) formulations are being developed under GMP norms based on studies under the network project with selected plant extracts screened for antioxidant, neuroactive, antihyperlipidemic activities, quality assurance and safety studies. These formulations are:

(i) Health promoter for aged population
(ii) Health promoter for diabetic patients
(iii) Health promoter for cancer patients

Coded extracts NSHP(l-4)08(LKO)P15; NSHP(l-3)011L(AVS)P05 and NSHP(l-2) 004L (LKO)P14 were tested for anti-hyperglycemic and anti-oxidant activity. The peak glucose level was maximally suppressed by NSHP(l-4)08(LKO)P15 (33.38%) at the dose of 50mg/kg and NSHP(l-3)011L(AVS)P05 at the dose of 250mg/kg (25.36%). Minimum suppression of blood glucose was in NSHP (l-2) 004L (LKO) P14 at the dose of 250mg/kg. Supplementation of medicinal plant extracts to diabetic rats had no toxic effect as evident from SGPT, SGOT, creatinine values and hematological parameters suggesting their safety. Glutathione reductase (GR), catalase (CAT) and superoxide dismutase (SOD) activities in diabetic rats were decreased while lipid peroxidation increased significantly ($p< 0.001$) as compared to controls. All the three extracts enhanced the antioxidant enzyme activities in diabetic rats which was statistically significant. Supplementation of NSHP(l-4)08(LKO)P15 extract to diabetic rats showed highest increase in antioxidant enzymes (SOD, GR and CAT) and decrease in lipid peroxidation, and a maximum of 3.2 fold increase in GR activity. All three extracts decreased the MDA content significantly ($p<0.001$). NSHP(l-2)004L(LKO)P14 supplementation increased antioxidant enzymes in a dose-dependent manner.

A decrease in Glucose-6-phosphate dehydrogenase as well as glucokinase, and increase in glucose-6-phosphatase activity was observed in diabetic animals as compared to their control counterparts. NSHP(l-4)08(LKO)P15 and NSHP(l-3)011L(AVS)P05 extracts were found to have significant ($p< 0.001$) reversal of these enzymatic activities whereas NSHP(l-2)004L(LKO)P14 was ineffective in altering carbohydrate metabolism. NSHP(l-4)08(LKO)P15 was found to have significant antihyperglycemic activity at low doses (50mg/kg) and capacity to alter carbohydrate metabolism alongwith restoration of antioxidant activity to normal level. NSHP(l-2)004L(LKO)P14 although lowered blood glucose on 15 days treatment but did not alter activity of glycolytic or gluconeogenic enzymes.

Discovery, development and commercialization of new bioactive and traditional preparations

Herbal preparations/extracts were screened to assess their psychoactive potential using *in vitro* neurotransmitter receptor screen. A total of 1558 extracts were screened for their activity on dopamine-D2, cholinergic-muscarinic, serotonin-2A and benzodiazepine receptors during January 2006 to December 2006. Based on the

in vitro screening of extracts on different receptor targets, 130 extracts were found active. (25 Dopamine-D2 receptors, 49 Cholinergic-muscarinic receptors, 28 serotonin-2A receptors and 28 benzodiazepine receptors). The extracts/samples found active on receptor targets *in vitro* have been recommended for *in vivo* screening on animal models of disease condition in the coordinating laboratories to check their efficacy.

Anti-psychotic activity of pre-screened extracts exhibiting high dopaminergic inhibitory activity was assessed on mouse model of amphetamine induced hyperactivity. A total of 61 extracts were screened out of which 3 have been found active. Single molecule from CIMAP sample has been isolated and significant anti-psychotic activity has been reported. The molecule has been included in the drug discovery group. Six lead molecules found to have neuroactivity in repeat experiments were tested for antioxidant capacity and 2 were reported to be strong antioxidants after testing on multiple screens. Three more samples found to have other biological activity are being tested for antioxidant capacity.

Effect of herbal hepatoprotective agent 'Silymarin'against the selected hepatotoxins

Studies were undertaken to elucidate the role of silymarin, a herbal antioxidant, on rifampicin- and pyrogallol-induced hepatotoxicity in mouse liver. Briefly, male Swiss albino mice were treated intraperitoneally with rifampicin (20mg/kg) and/or pyrogallol (40mg/kg) for 1, 2, 3 and 4 weeks. In some experiments, animals were treated with silymarin (40 mg/kg), 2 h prior to rifampicin and/or pyrogallol. The differential expression and catalytic activity of cytochrome P-450 (*CYP) 1A1*, *CYP1A2* and *CYP2E1* were measured in the liver of control and treated groups. *CYP1A1* expression and catalytic activity were not altered following individual or combinational treatment. A significant augmentation in the expression and activity of *CYP1A2* and *CYP2E1* was observed following pyrogallol and rifampicin + pyrogallol treatment. However, rifampicin exhibited a significant induction of *CYP2E1* only. Silymarin restored the rifampicin- and/or pyrogallol-induced alterations in the expression and activity of *CYP1A2* and *CYP2E1*. The results demonstrate evidence of the involvement of silymarin in attenuation of drug-induced hepatotoxicity.

Safety evaluation of selected herbs used in Ayurveda and Siddha medicine

Safety evaluation of herbal products and contaminant testing in terms of heavy metals, persistent pesticides and microbial load are being carried out under a project funded by Department of AYUSH. The studies carried out include (a) Estimation of heavy metals such as Pb, Cd, Cr, Ni, As and Hg and persistent organochlorine pesticides in 160 samples of therapeutically important medicinal plants (b) Microbial load in terms of total bacterial and fungal count in 160 samples which were also tested for the presence of *Escherichia coli, Salmonella*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* as per WHO guidelines (c) Acute oral toxicity studies as per OECD guideline 420 in 4 samples out of the 20 samples which include *asavas* and *arishtas.*

Heavy metals and persistent pesticides analysis in selected Indian medicinal plants

In the phase II of this invited project sponsored by ICMR about 180 medicinal plants extensively used by manufacturers of Ayurvedic medicines have been selected and samples are being supplied by five laboratories involved in the Task Force Project. Heavy metals like Pb, Cd, Cr, Ni, As and Hg have been estimated in 356 medicinal plant samples belonging to 130 plant species whereas organochlorine pesticides have been estimated in 254 samples in the past one year. Report on the data generated has been digitised on QAMP database developed in Herbal Research Lab. This database now has more than 32000 data entries covering more than 1400 medicinal plant samples.

Safety evaluation of Ayurvedic *Bhasmas*

Two coded *bhasma* samples U and V were tested for sub-acute and sub-chronic toxicity following the protocol developed by Department of AYUSH based on OECD guidelines. Repeated administration of *Bhasma* sample U and V at therapeutic dose (TD), 5 TD and 10 TD for 90 days in rats and mice produced no signs of toxicity. Autopsy of animals at the end of observation period did not indicate any gross pathological change in their vital organs. Biochemical and haematological parameters also did not show any significant alteration and values were found to be comparable to control. No histopathological changes in selected tissues even at highest dose (10 TD) were observed.

Golden Triangle Partnership Project for standardization and safety evaluation of Ayurvedic formulations/herbo-mineral drugs

A new initiative has been taken by CSIR, ICMR and Department of AYUSH in the form of Golden Triangle Partnership project to scientifically validate traditional medicine and develop new formulations for identified disease conditions. Medicinal plant samples received under the project were tested for heavy metals, pesticides and microbial load before selection as raw material for formulations. Two formulations, GTP-0037 for management of anxiety neurosis and GTP-0050 for Dyslipidemia, were tested for acute toxicity using OECD guideline 420. Both were found to be non-toxic. Herbo-mineral formulations i.e. *Mahayogaraj Guggulu, Arogyavardhini vati* and *Mahalaxmi vilas rasa* were also found to be safe when subjected to oral acute toxicity studies.

Induction of apoptosis by green and black tea polyphenols through Bax translocation, cytochrome c release and caspase activation in mouse skin tumors

Tea *(Camellia sinensis)* is the most consumed beverage in the world after water. The consumption of tea has been shown to have beneficial health effects against several chronic diseases including cancer. The most abundant and active constituents of tea are polyphenols (epigallocatechin gallate and theaflavins). The current work was carried out to evaluate the cancer chemopreventive properties of both green tea

polyphenols (GTP) and black tea polyphenols (BTP) on 7,12 dimethylbenz[a]anthracene (DMBA) induced mouse skin tumorigenesis. Both GTP and BTP, given orally as a sole source of drinking water, reflected a marked delay in DMBA induced onset of tumorigenesis. We also demonstrated the modulatory effect of both GTP and BTP on the expression of proteins involved in apoptotic pathway as a mechanism of its cancer chemoprevention. Tea polyphenols treatment along with DMBA exposure resulted in an upregulation of tumor suppressor protein p53, and its downstream regulator Bax, whereas enhanced expression of antiapoptotic proteins, Bcl-2 and survivin by DMBA, were downregulated. Tea polyphenols supplementation resulted in the release of cytochrome c, caspases activation, and increase in apoptotic protease activating factor (Apaf-1) and poly (ADP-ribose) polymerase (PARP) cleavage as a possible mechanism of apoptosis induction. Thus, from the present study it was inferred that the polyphenolic constituents present in green tea and black tea induce mitochondrial pathway of apoptosis and hence can be used as a potential chemopreventive agent against skin cancer.

Black tea polyphenol induces G2/M arrest and apoptosis in PC-3 human prostate carcinoma cells

In order to evaluate the chemopreventive potential of black tea polyphenols (BTP) on prostate cancer, on cellular proliferation and cell death were evaluated in PC-3 cell line. Briefly, as determined by MTT assay, BTP inhibited the cell proliferation in a dose-and time-dependent manner. Cell cycle analysis showed that antiproliferative effect of BTP is associated with an increase in G2/M phase of PC-3 cells, which was mediated through inhibition of cyclin regulated signaling pathway. BTP was found to induce cyclin kinase inhibitor $p21^{waf1/cip1}$ expression as well as inhibited cdc25C and cyclin B expression. Increase in exposure time of BTP resulted in apoptosism PC-3 cells, which was associated with upregulation of pro-apoptotic protein bax, caspase-3 and caspase-9, and downregulation of anti-apoptotic protein bcl-2. The role of caspase-induced apoptosis was confirmed by reduction in mitochondria membrane potential and DNA fragmentation. It can be inferred that BTP acts as an effective antiproliferative agent by modulating cell-growth regulators.

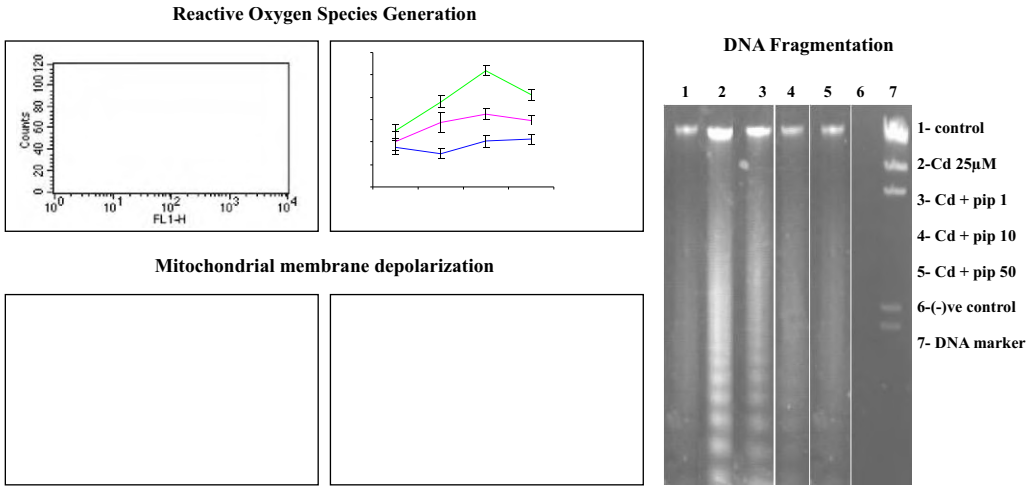
Chemopreventive effects of black tea and its constituents

Chemopreventive assessment of black tea extract black tea polyphenol (BTE/BTP) components at molecular level were carried out by induction of apoptosis and expression of multidrug resistance (MDR) gene in cancer cells. For evaluating apoptosis, TUNEL and DNA fragmentation assays were performed which showed a marked induction after 48 h in BTP (conc. 0.10%, 0.15% and 0.20%) treated PC-3 cells in a dose-dependent manner. Modulatory effect of BTE/BTP on multidrug resistance gene (MDR) was observed on human myelogenous leukemia K562 cell line. Black tea inhibited the growth of the resistant cells to a greater extent than the parental sensitive cells. BTP/BTE was assessed at increasing concentrations for its ability to sensitize K562/R10 cells to the cytotoxicity of VBL which was 50% at 72 h exposure to 0.05% concentration that had no effect on the viability of K562/R10 and K562/S cells. At concentrations higher than 1.0%, BTP/BTE became cytotoxic to both resistant and sensitive K562 cells after 48 or 72 h. However, at 24 h

exposure, 37% sensitization of K562/R10 cells was observed with 1.0% BTP/BTE. In case of parental K562/S cells, 50% sensitization was observed at 0.15/0.2% BTP/BTE respectively. To verify that the differential inhibitory activity of BTP/BTE on resistant and parental cells is due to the modulation of P-gp, western blotting and immunohistochemical experiments were performed by using a specific antibody for P-gp (clone JSB-1). The parental K562/S line expresses low but detectable amounts of P-gp whereas resistant K562/R10 cells overexpress P-gp. BTP/BTE (0.15/0.2%) exposure resulted in a time-dependent reduction in P-gp level in K562/R10 cells, with maximum activity being observed after 72 h. The immunocytochemical staining of BTP/BTE-exposed K562/S and K562/R10 cells further confirmed these observations. K562/S cells showed 0.85% of the area positive for P-gp whereas in K562/R10 cells 10.25% of the area was positive for P-gp expression. Inhibition of P-gp expression in BTP/BTE-exposed cells was found to be 26/24, 42/40, and 85/72%, respectively for 24, 48, and 72 h. BTP/BTE had no effect on P-gp expression in parental K562/S cells suggesting its non-toxic nature. The present study demonstrates that BTP is a novel, selective, growth regulator of cancer cells as well as a highly potent modulator of MDR.

Immunomodulatory efficacy of piperine on cadmium exposed murine splenocytes and thymocytes

Piperine (main component of *Piper longum* Linn. and *Piper nigrum* Linn.) is a plant alkaloid with a long history of medicinal use in India. It is known to exhibit a variety of biological activities. Immunomodulatory efficacy of piperine was studied to assess the mitigation effect against the cadmium-induced immunotoxicity which include its anti-pyretic, anti-inflammatory, anti-depressant, hepato-protective and anti-tumor activities. Under *in vitro* and in *vivo* conditions, piperine (2.5 mg/kg/day,

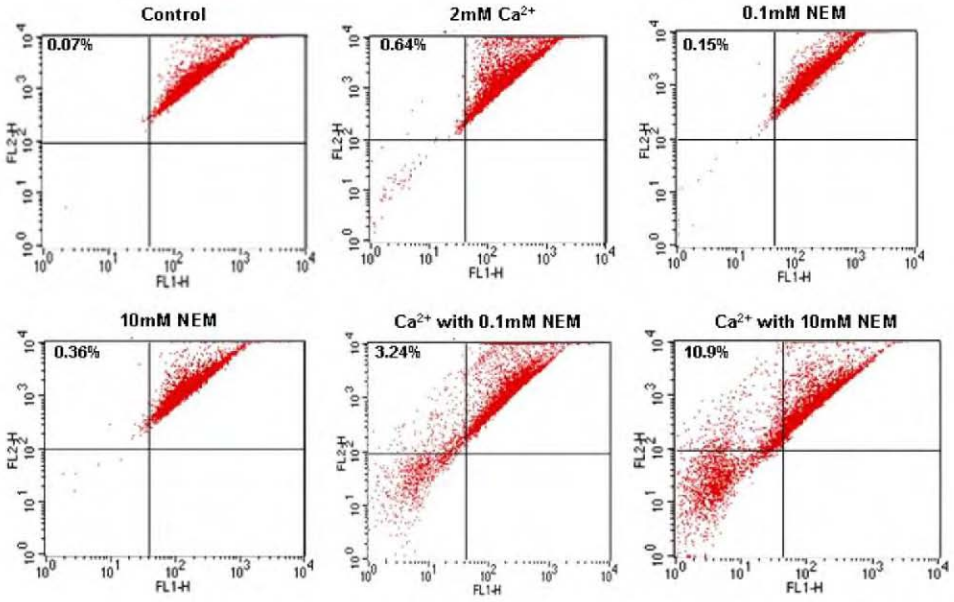


oral for 7 days) pretreated Balb/C mice were administered a single dose of Cd as $CdCl_2$ (1.8mg/kg, i.p., 4th day). For *in vitro* studies, thymic and spleen cells were exposed to Cd and variable concs of piperine for different time periods. The various biochemical parameters such as cytotoxicity (MTT assay), oxidative stress

indicators (glutathione, reactive oxygen species), apoptotic markers (mitochondrial membrane potential, caspase-3 activity, phosphatidylserine externalization, apoptotic DNA, intranucleosomal DNA fragmentation), phenotyping, cell proliferative response and cytokine release (IL-2 and gamma IFN) were assessed. Reduction of body weight gain and cellularity and a loss in cell viability was seen in the Cd treated mice. These changes were abrogated by piperine treatment. The loss in cell viability, ROS generation, followed by mitochondrial membrane depolarization, caspase-3 activation and GSH depletion with Cd were also mitigated by piperine. The Cd led pronounced inhibition of cell proliferative response, alterations in T and B phenotypes, cytokine release and morphological alterations were also significantly restored. Piperine under *in vitro* conditions also exhibited similar immunomodulatory effects. These results demonstrate high protective ability of piperine and hence has the potential to be a drug for Cd-induced immunotoxicity.

Studies on the mitochondrial redox regulation during hepatotoxicity

Studies were conducted to unravel the effect of altered calcium homeostasis and glutathione depletion on mitochondrial integrity and functions. Effect of calcium overload on *in vitro* mitochondrial swelling (change in membrane permeability) of isolated rat liver mitochondria was studied and compared with the swelling under the condition of glutathione depletion and reactive oxygen species generation inside



Flow cytometric estimation of mitochondrial membrane potential using JC-1 cationic fluorescent dye

isolated rat liver mitochondria. Mitochondrial electron flow was found to be decreased significantly with increased glutathione depletion which was more significant when mitochondria were loaded simultaneously with calcium and NEM (glutathione depleting agent). Flow cytometric studies using JC-1 dye showed that calcium as well as GSH depletion increased number of low membrane potential mitochondria by 9 folds and 2-5 folds, respectively which further increased (53-

188%) when dual stress was used. DCHF-DA dye was employed to detect ROS generation and it was found to be enhanced (more than 2 folds) in GSH depleted rat liver mitochondria whereas combined effect of the two stressors further enhanced ROS generation. t-BHP(250μM) in the presence of varying concentrations of NEM (0.1-10 mM) induced ROS generation from 2-23 folds. Calcium overload and lower concentration of NEM (i.e. 0.1mM) increased SOD activity significantly ($p<0.001$) by 34 & 44% whereas higher concentrations i.e. 1-10 mM NEM alone decreased SOD activity by 28 to 74% ($p<0.01$ and 0.001). Further studies are in progress to see the effect of glutathione depletion and calcium overload on mitochondrial DNA integrity.

Protective effect of *Glycyrrhiza glabra* L. root extract and glycyrrhizic acid against oxidatively stressed hepatocytes

Studies were undertaken to investigate the cytoprotective and antioxidant potential of *Glycyrrhiza glabra* Linn. commonly known as liquorice and one of its biologically active constituent glycyrrhizic acid (GA). The antioxidant potential of alcoholic extract of *Glycyrrhiza glabra*/ GA and its modulatory effect on tert-butyl hydroperoxide (t-BHP) induced cytotoxicity was studied in primary rat hepatocytes as a model and compared to silymarin, a known hepatoprotectant. Treatment with extract as well as its constituent resulted in protective restoration of decreased antioxidants in t-BHP treated cells. Primary hepatocytes subjected to oxidative stress using different concentrations (50-200μM) of t-BHP showed decrease in cell survival rate ranging from 25 to 49%. Standardized extract of *G. glabra* Linn. (root) and its constituent GA was found to increase the cell survival rate as indicated by MTT reduction assay. t-BHP caused decrease in activities of SOD, NO quenching capacity, GSH content and elevated the level of TBARS formation. Pre-treatment with extract (10μg) as well as its constituent GA (4μg) restored all the antioxidants significantly and lowered the levels of LPO. Elevated level of LPO was decreased from 0.55 to 0.23 nM MDA formation/10g of extract and 0.19nM MDA at 4g of GA. Similarly, NO quenching capacity was found to be high in the cells pre-treated with extract and GA i.e. 39.18% and 38.69% respectively. Radical scavenging capacities of the *G. glabra* extract and GA (5 times higher concentration than present in extract) was comparable indicating that extract has higher antioxidant potential. This also indicates synergistic antioxidant effect of other constituents present in the standardized extract. The study confirms antioxidant and cytoprotective effect of standardized *G. glabra* extract against oxidative stress mediated hepatotoxicity in cultured primary hepatocytes which was comparable to silymarin.

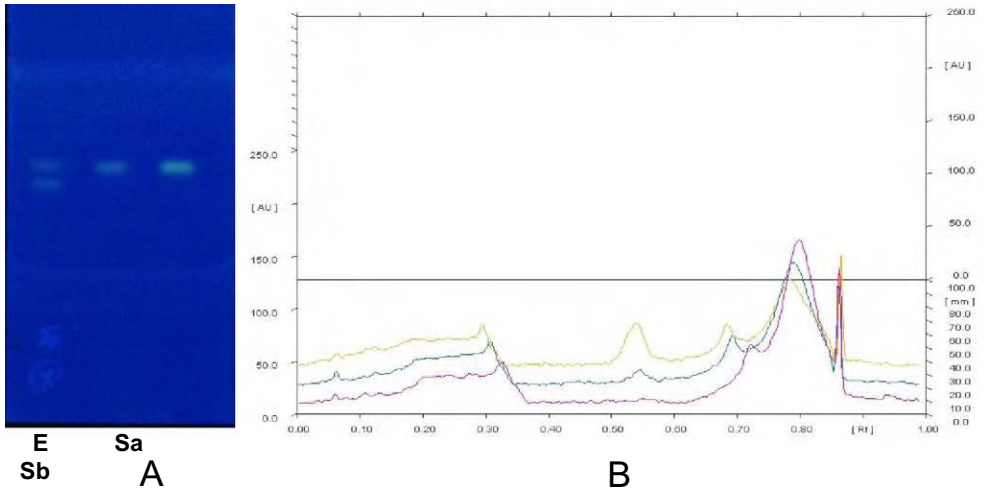
Anti-hyperglycemic effect of *Berberis aristata* root extract containing berberine and its role in ameliorating oxidative stress in diabetic rats

Anti-hyperglycemic and antioxidant effects of 50% aqueous alcoholic root extract of *Berberis aristata* in alloxan induced diabetic rats was explored along with the carbohydrate metabolism regulating enzymes. The constituents of root extract were identified as berberine, berbamine and palmatine through HPTLC. Berberine was isolated using anion exchange resin and was identified by UV, IR, Mass and

NMR spectra. Diabetes was induced by injecting alloxan monohydrate (100mg/kg) to 16 h starved rats. Dose optimization of extract was done using oral glucose tolerance test (OGTT) and 250mg/kg bw was found to be an effective dose. Oral administration of *Berberis aristata* root extract to diabetic rats showed significant gradual decrease in blood glucose without any hypoglycemic effect in normal rats. Decreased antioxidant enzyme activities, increased lipid peroxidation and protein carbonylation was observed in diabetic animals as compared to their control counterparts. A significant increase in bodyweight and antioxidant enzymes such as catalase (41.04%), superoxide dismutase (90.32%), glutathione peroxidase (36.68%) and reduction in carbonyl content (30.15%) and MDA (41.6%) were observed in extract treated diabetic rats. In diabetic rats, glucokinase and glucose-6-phosphate dehydrogenase activities were decreased whereas glucose-6-phosphatase activity was increased significantly which reverted back on extract treatment and was comparable to glybenclamide treated rats. In addition, liver glycogen decreased in diabetic rats which reverted to near-control levels in extract treated group. SGOT, SGPT, blood urea and creatinine levels declined as an effect of extract supplementation in diabetic rats, suggesting its adaptogenic nature.

Bioprospection of antioxidant potential of *Pinus roxburghii* Sarg collected from different Himalayan regions of India

Pinus roxburghii Sarg. is a common species of Pine, which grows along the lower altitudes of Indian Himalayas all along the Siwalik range and the valleys of almost all the important rivers emerging out of Himalayas. It is traditionally used as a medicine



Quantification of berberine alkaloid in Berberis aristata root extract through HPTLC; A: TLC plate at 366 nm; lane E: methanolic extract (0.3g) ; lane Sa: berberine lane(0.03g) Sb:berberine (0.06µg); B: Scanning spectra of plate.

and the resin from the stem is used as insect repellent and in some varnishing industry. The aim of this study was to evaluate the chemical constituents and antioxidant potential of the bark of *P. roxburghii* Sarg collected from different Himalayan regions of India. *P. roxburghii* barks and leaves were collected from Nainital (Uttarakhand), Palampur (Himachal Pradesh), and Darjeeling (West Bengal). Quantification of total phenolics, flavonoids, proanthocyanidins and

tannins of the bark extracts was done. The antioxidant potential of the bark extracts was determined by assaying the SOD mimetic activity, inhibition of lipid peroxidation, NO quenching capacity, Hydrogen peroxide scavenging activity and ABTS decolourization assay. Himachal Pradesh sample contained the highest amount of flavonoid and proanthocyanidins(1.097 g kg^{-1} and 0.315 g.kg^{-1} resp.) in comparison to the samples of the other two regions while the samples of Uttarakhand and Darjeeling contained higher quantity of phenolics(12.73g. kg^{-1} and 12.67g. kg^{-1} resp.) and tannins(7.47g.kg^{-1} and 7.88g.kg^{-1} resp). Highest SOD mimetic activity was exhibited by the Uttarakhand specimen (373.90 units.min^{-1}.mg^{-1} extract) which was higher than that of catechin (positive control) by 85.67%. The Uttarakhand sample showed highest percentage inhibition of MDA formation (97.33%) which was higher than that of catechin by 41.75%.The Darjeeling sample showed highest percentage inhibition of NO release at 4.0 µg concentration (64.79%). All the samples showed hydrogen peroxide decomposing activity higher than that of catechin which was highest in case of Himachal Pradesh sample(15.92µM.mg^{-1} bark).The total antioxidant capacity as measured by ABTS radical assay was highest in Uttarakhand sample (8.275mM.mg^{-1} dry bark) followed by Himachal Pradesh and Darjeeling.

Hepatoprotective effects of lupeol and mango pulp extract in carcinogen induced alteration in Swiss albino mice

Lupeol, a triterpene present in mango and other fruits, is known to exhibit a number of pharmacological properties, including anti-oxidant, anti-lithiatic and anti-diabetic effects. In the present study, chemopreventive properties of lupeol and mango pulp extract (MPE) were evaluated against 7,12- dimethylbenz(a)anthracene (DMBA) induced alteration in liver of Swiss albino mice. Lupeol (25 mg/kg b.wt.) or 1 ml of 20% (w/v) aqueous MPE/mouse were given once daily for a week, after a single dose of DMBA (50 mg/kg b.wt.). Lupeol/MPE supplementation effectively influenced the DMBA induced oxidative stress, characterized by restored anti-oxidant enzyme activities and decrease in lipid peroxidation. A reduction of apoptotic cell population in the hypodiploid region was observed in lupeol and MPE supplemented animals. The inhibition of apoptosis was preceded by decrease in reactive oxygen species (ROS) level and restoration of mitochondrial transmembrane potential followed by decreased DNA fragmentation. In DMBA treated animals, downregulation of anti-apoptotic Bcl-2 and upregulation of proapoptotic Bax and Caspase-3 in mouse liver was observed. These alterations were restored by lupeol/MPE, indicating inhibition of apoptosis. Thus, lupeol/MPE was found to be effective in combating oxidative stress induced cellular injury of mouse liver by modulating cell-growth regulators.

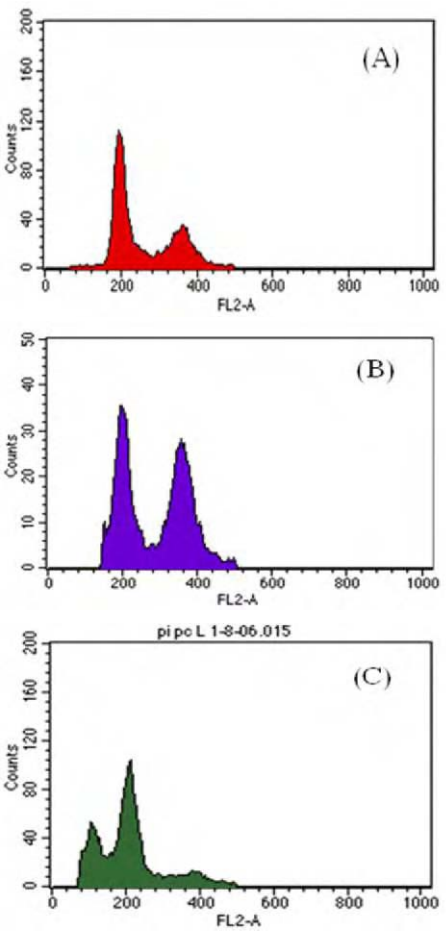
Antigenotoxic effects of lupeol and mango pulp extract against benzo[a]pyrene induced clastogenicity in mouse bone marrow cells

In the present study, the antigenotoxic potential of lupeol, a triterpene, and mango pulp extract (MPE) has been evaluated in Swiss albino mice. Benzo[a]pyrene (B[a]P), a well-known mutagen, was given at a single dose of 100 mg/kg b.w. intraperitoneally. Pre-treatment with lupeol (1 mg/animal) and MPE [1ml (20%

w/v)] was given through oral intubation for 7 days prior to B[a]P administration. Animals from all the groups were sacrificed at sampling time of 24 h and their bone marrow tissue was analyzed for chromosomal damage and micronuclei induction. In B[a]P treated animals, a significant induction of chromosomal aberration and micronuclei was recorded with decrease in mitotic index. In lupeol/MPE supplemented groups, a significant decrease in B[a]P induced clastogenicity was recorded. The incidence of aberrant cells and micronuclei was found to be reduced by both lupeol and MPE when compared to B[a]P treated group. The anticytotoxic effects of lupeol/MPE were also evident, as observed by significant increase in mitotic index. Thus results of the present investigation revealed that lupeol/MPE has chemopreventive potential against B[a]P induced genotoxicity in Swiss albino mice.

Lupeol promotes apoptosis in prostate cancer cells PC-3 through cell cycle arrest at G_2/M phase, caspase-3 activation and DNA fragmentation

Prostate cancer is the most frequently diagnosed non-cutaneous cancer and the leading cause of cancer related deaths in the United States as well as in the Asian countries. Chemoprevention may be considered as a promising strategy to control or reduce the risk of prostate cancer. In the present study, effect of lupeol on cellular proliferation and cell death was evaluated in prostate cancer cells PC-3. Lupeol inhibited the cell proliferation (12-71%) in a dose (50-800µM) and time-(24, 48 and 72 h) dependent manner, which was determined by MTT assay. Flow cytometric analysis of cell cycle revealed that anti-proliferative effects of lupeol was associated with an increase in G_2/M-phase arrest (34-58%) of cell cycle. The reverse transcription PCR (RT-PCR) analysis showed that lupeol-induced G_2/M-phase arrest was mediated through the inhibition of cyclin regulated signaling pathway. Lupeol inhibited the expression of cyclin B, cdc25C and plk1 as induced the expression of 14-3-3 genes but did not change the gadd45, p21waf1/cip1 and cdc2 gene expression. Result of western blot showed lupeol regulates the phosphorylation of cdc2 (Tyr15) and cdc25C (Ser198). Further, the treatment of PC-3 cells with lupeol for 96 h resulted in significant increase in apoptotic cell death, which was associated with upregulation of proapoptotic bax, caspase-3,



Flow cytometric analysis histograms of G_2/M-phase arrest and apoptosis in lupeol treated PC-3 cells. (A) No treatment. (B) The G_2/M peak increases at 48 h of lupeol exposure (C) but when exposure time extended to 96 h lupeol induces apoptosis with corresponding decrease in G2/M peak.

-9 and apaf1 genes and down regulation of antiapoptotic bcl-2 gene. The role of caspase-induced apoptosis was confirmed by loss of mitochondrial membrane potential followed by DNA fragmentation. The study suggests that lupeol possesses novel anti-proliferative and apoptotic potential against prostate cancer cells *in vitro.* Further *in vivo* studies are warranted to understand the mechanistic approach of lupeol in prostate cancer.

Collection, collation and digitization of toxicity data and antidote potential of medicinal plants used in Ayurveda

Toxicological information and antidote potential of medicinal plants used in Ayurveda is being compiled for value addition under this project. The list of plants has been provided by NISCAIR. Literature search on active constituents, toxicological parameters and antidote potential of 225 medicinal plants has been carried out adding to a total of 800 plants. Information on the toxic potential of the plant as such and its active constituents too is being compiled. In order to digitize this information, entry of the compiled data is being carried out in the software provided by NISCAIR. Data of 515 plants have been digitized.

Molecular and cellular mechanisms involved in neurotoxicity

Functional restoration using basic fibroblast growth factor (bFGF) infusion in kainic acid induced cognitive dysfunction in rat: neurobehavioral and neurochemical studies

Neurogenesis occurs in dentate gyrus of adult hippocampus under the influence of various mitogenic factors. Growth factors besides instigating the proliferation of neuronal progenitor cells (NPCs) in dentate gyrus, also supports their differentiation to cholinergic neurons. In the present study, an attempt has been made to investigate the neurotrophic effect of bFGF in Kainic acid (KA) induced cognitive dysfunction in rats. Stereotaxic lesioning using (KA) was performed in hippocampal CA3 region of rat's brain. Four-weeks post lesioning rats were assessed for impairment in learning and memory using Y maze followed by bFGF infusion in dentate gyrus region. The recovery was evaluated after bFGF infusion using neurochemical, neurobehavioral and immunohistochemical approaches and compared with lesioned group. Significant impairment in learning and memory ($p < 0.01$) was observed in lesioned animals. Four weeks post-lesioning exhibited significant restoration ($p<0.01$) following bFGF infusion twice at one and four week post-lesion. The bFGF infused animals exhibited recovery in hippocampus cholinergic (76%)/ dopaminergic (46%) receptor binding and enhanced choline acetyltransferase (ChAT) immunoreactivity in CA3 region. The results suggest restorative potential of bFGF in cognitive dysfunctions, possibly due to mitogenic effect on dentate gyrus neurogenic area leading to generation and migration of newer cholinergic neurons.

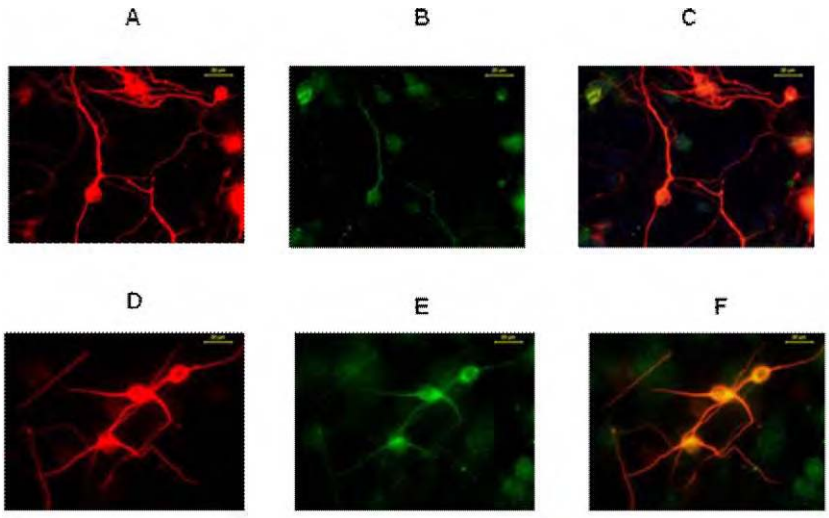
Overexpression of cerebral and hepatic cytochrome P450s alters behavioral activity of rat offspring following prenatal exposure to lindane

Studies to understand developmental neurotoxicity of lindane, an organochlorine insecticide, revealed that oral administration of low doses (0.0625, or 0.125 or 0.25 mg/kg corresponding to $1/1400^{th}$ or $1/700^{th}$ or $1/350^{th}$ of LD_{50}) of lindane, to the pregnant wistar rats from gestation day 5 to 21 were found to produce a dose-dependent increase in the activity of cytochrome P450 (CYP) dependent 7-ethoxyresorufin-O-deethylase (EROD), 7-pentoxyresorufin-O-dealkylase (PROD) and N-nitrosodimethylamine demethylase (NDMA-*d*) in brain and liver of offspring post-natally at 3 weeks. The increase in the activity of CYP monooxygenases was found to be associated with the increase in the mRNA and protein expression of xenobiotic metabolizing CYP1A, 2B and 2E1 isoenzymes in the brain and liver of offspring. Dose- dependent alterations in the parameters of spontaneous locomotor activity in the offspring post-natally at 3 weeks have suggested that increase in CYP activity may possibly lead to the formation of metabolites to the levels that may be sufficient to alter the behavioral activity of the offspring. Interestingly, the inductive effect on cerebral and hepatic CYPs was found to persist post-natally upto 6 weeks in the offspring at the relatively higher doses (0.125- and 0.25 mg/kg) of lindane and upto 9 weeks at the highest dose (0.25 mg/kg), though the magnitude of induction

was less than that observed at 3 weeks. Alterations in the parameters of spontaneous locomotor activity in the offspring post-natally at 6 and 9 weeks, though significant only in the offspring at 3 and 6 week of age, have further indicated that due to the reduced activity of the CYPs during the ontogeny, lindane and its metabolites may not be effectively cleared from the brain. The data suggests that low dose pre-natal exposure to the pesticide has the potential to produce overexpression of xenobiotic metabolizing CYPs in brain and liver of the offspring which may account for the behavioral changes observed in the offspring.

Differences in the expression and inducibility of cytochrome P450 2B isoenzymes in cultured rat brain neuronal and glial cells

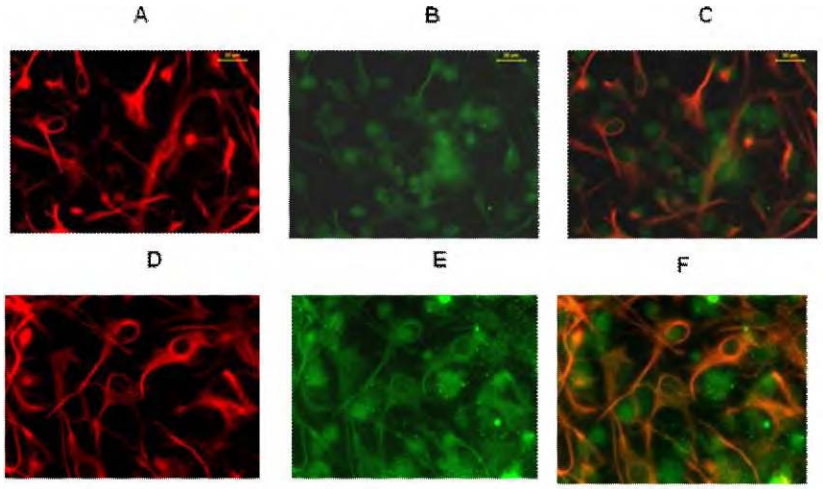
Studies initiated to investigate the distribution of cytochrome P450 2B (CYP2B) isoenzymes in rat brain cells revealed significant activity of CYP2B-dependent 7-pentoxyresorufin-O-dealkylase (PROD) in microsomes prepared from both cultured



Immunocytochemical detection of CYP2B in cultured rat brain neuronal cells. A, B & C represent primary cultures of neuronal cells in DMEM. D, E & F represent cultures of neuronal cells in DMEM+PB. A & D show cell in culture that are positive for b-III tubulin (red-TRITC), a neuronal marker. B & E show Immunoreactivity in the same neuronal cells with anti-CYP2B1 (green-FITC). C & F represent on overlay of the two images control and PB treated respectively. Original magnification x 40, scale 20 µm.

rat brain neuronal and glial cells. Neuronal cells exhibited 2-fold higher activity of PROD than the glial cells. RT-PCR and immunocytochemical studies demonstrated significant constitutive mRNA and protein expression of CYP2B in cultured neuronal and glial cells. Induction studies with phenobarbital (PB), a known CYP2B inducer, revealed significant concentration-dependent increase in the activity of PROD in cultured brain cells with glial cells exhibiting greater magnitude of induction than the neuronal cells. This difference in the increase in enzyme activity was also observed with RT-PCR and immunocytochemical studies indicating differences in the induction of CYP2B1 and 2B2 mRNA as well as protein expression in the cultured brain cells. Further, a greater magnitude of induction was observed in CYP2B2 than CYP2B1 in the brain cells. Our data indicating differences in the expression and sensitivity of the CYP2B isoenzymes in cultured rat brain cells will help in identifying and distinguishing xenobiotic metabolizing capability of

these cells and understanding the vulnerability of the specific cell types towards neurotoxins.



Immunocytochemical detection of CYP2B in cultured rat brain glial cells. A, B & C represent primary cultures of Glial cells in DMEM. D, E & F represent cultures of glial cells in DMEM+PB. A & D show cells in culture that are positive for GFAP (red-TRITC), a glial marker. B & E show immunoreactivity in the same glial cells with anti-CYP2B1 (green-FITC). C & F represent an overlay of the two images control and PB treated respectively. Original magnification x 40, scale 20 µm.

Influence of cytotoxic doses of 4-hydroxynonenal on the expression of neurotransmitter receptors in PC-12 cells

The effect of 4-hydroxynonenal (HNE) on the sensitivity of various neurotransmitter receptors in PC-12 cells was evaluated. Initially, cytotoxicity profiling of HNE was carried out using HNE concentrations 0.1-50µM for 30 min to 24 h. The endpoints selected were, trypan blue dye exclusion, MTT, LDH release and neutral red uptake (NRU) assays. Significant cytotoxic responses were observed by minimum 2 h of exposure, except for HNE at 50 µM, where cytotoxicity was exerted even at 90 min. HNE concentrations 10-50µM were found to be cytotoxic, 2-5µM cytostatic and 0.1-1µM non-cytotoxic. Neurotransmitter receptors studies were carried out using specific radio-ligands with selected doses of HNE (1, 10, 25 and 50µM for 1-8 h). Significant decrease in binding of ^{3}H-QNB, ^{3}H-Fluinitrazepam and ^{3}H-Ketanserin, known to label cholinergic-muscarinic, benzodiazepine and serotonin $5HT_{2A}$ receptors respectively was observed even at 1 hr exposure with 25 and 50µM concentrations of HNE. Whereas, significant inhibition in binding of ^{3}H-Spiperone to DA-D2 receptor was started at 4 h of exposure and continued till 8 h. Specific binding with ^{3}H-Fluinitrazepam and ^{3}H-Ketanserin was reached to saturation at dose of 50µM for 4 h and onwards. PC-12 cells have shown particular vulnerability to cytotoxic concentrations of HNE. Experimental HNE exposure provides an intriguing model of toxicant-cell interactions, which most likely involves receptors in HNE neurotoxicity and leads to neurodegeneration.

Centromeric dysfunction/genotoxic effects in ethanol and lead co-exposed cultured human peripheral blood lymphocytes

The interaction of lead (Pb), a known toxicant, with genetic material is well documented, especially in occupationally exposed population. However, the cascade of events involved and mechanisms of genotoxicity are poorly understood. It has also been reported that exposure to environmental pollutants together with other habitual factors like consumption of ethanol and tobacco are key contributors to various diseases including cancer. In the present study, the possible genotoxic threat of ethanol on lead was investigated by analyzing the chromosomal aberrations (CA) and centromeric dysfunction in human peripheral blood lymphocytes (HPBL) as cytogenetic biomarkers. For the analysis of CA and centromeric dysfunction, human peripheral blood lymphocytes cultures were set up and exposed to either ethanol (50, 100, 200, 250 and 300 mM) or lead (10^{-6} M) and combination of both lead-ethanol. Cultures were incubated at 37 °C for 72 h. At 70^{th} h colchicine was added. Cells were harvested, staining was performed by giemsa and analyzed CA by automated software guided karyotyping. For centromeric dysfunction, metaphases were denatured using 70% formamide. The probes were denatured and hybridized with metaphase at 37°C for 24 h. For detection, anti-dig FITC was added and-counter stained with DAPI. Individual ethanol and lead showed no genetic damage in HPBL. Interestingly, co-exposure of lead and ethanol (200 mM, 250 mM) caused a dose-dependent induction in CA significantly (<0.01) against the control. Further, centromeric FISH in metaphase revealed the centromeric dysfunction following the co-exposure, where acentric fragments were reported. The study suggests that exposure to lead in the presence of ethanol makes genetic system more vulnerable under experimental conditions.

Oxygen glucose deprivation model of cerebral stroke in PC-12 cells: glucose as limiting factor

The suitability of PC-12 cells as rapid and sensitive *in vitro* model of cerebral stroke was examined based on the optimum time points for oxygen-glucose deprivation (OGD) and re-oxygenation. Further, precise role of glucose as one of the limiting factor was ascertained. PC-12 cells were subjected to receive OGD of 1-8 h followed by re-oxygenation for 6 to 96 h in medium having glucose 0-10mg/ml. Loss of cell viability was assessed using trypan blue dye exclusion and MTT assays. The significant ($p<0.05$) reduction in percent viable cell count was started at 2h of OGD (80.72.0) and continued in further OGD periods (3, 4, 5, 6, 7 and 8 h) i.e., 65.73.5, 59.74.6, 54.33.2, 44.72.9, 20.34.3, 5.72.0 of counted cells respectively. Cells growing in glucose free medium have shown gradual ($p<0.001$) decrease in cell viability throughout the re-oxygenation. Re-oxygenation of 24 h was found to be first statistically significant time point, for all the glucose concentrations. Glucose concentration during re-oxygenation was found to be one among the key factors involved in the growth and proliferation in PC-12 cells. The OGD of 6 h followed by a re-oxygenation period of 24 h with 4-6 mg/ml glucose concentration could be recorded as optimum conditions under our experimental conditions.

Effect of anaesthetic ether on dopamine receptors in platelets and brain

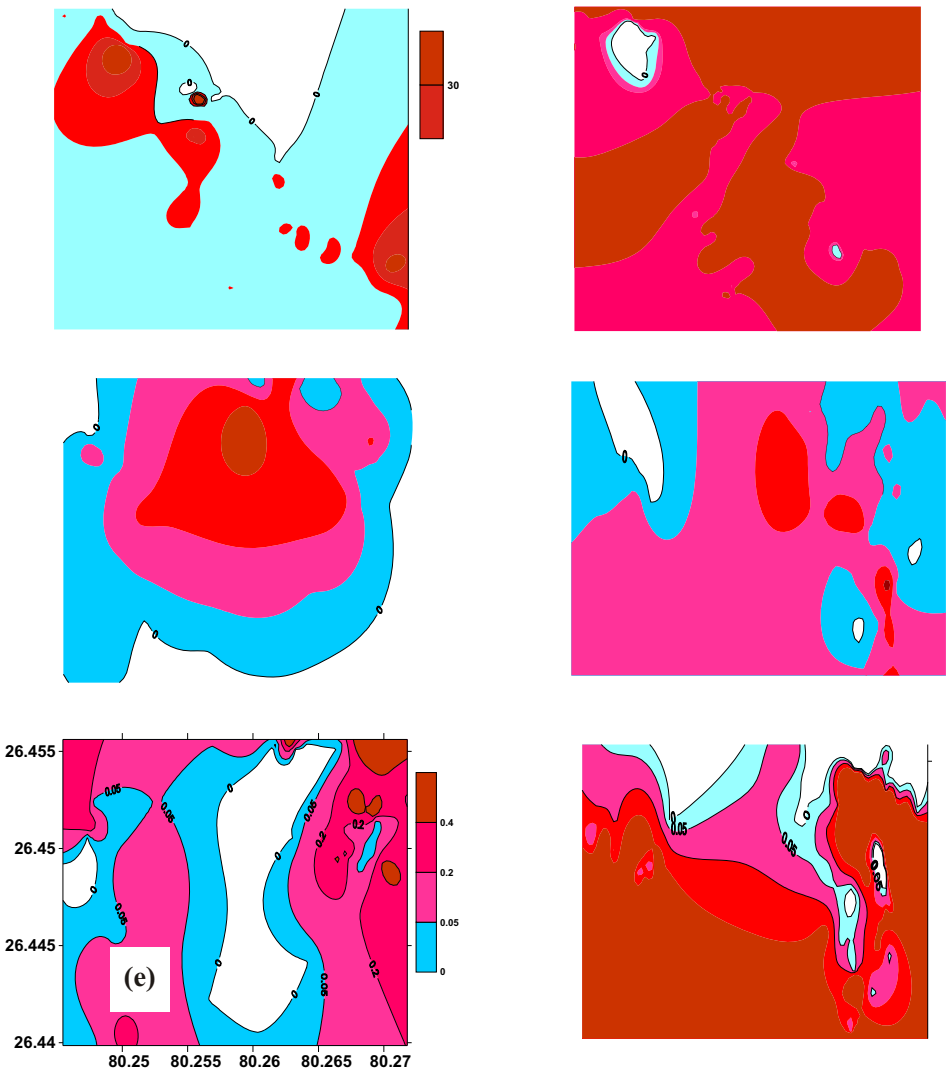
The effect of anaesthetic ether was studied on dopamine receptors in platelets and brain after different intervals. Exposure of rats to anaesthetic ether decreased the dopamine receptor binding both in platelets (27%) and striatum (16%) immediately after anesthesia as compared to controls. Rats exposed to anaesthetic ether once daily for 11 days also exhibited a decrease in the binding of ^{3}H-spiperone to platelet (24%) and corpus striatum (16%) although the degree of decrease differed in both the systems. Such an effect indicates that some of the alterations caused by anaesthetic ether in brain are manifested in platelets also. The study suggests that platelets could be a useful model to understand neuronal alterations.

Genotoxic effects of herbicide Roundup™ in bone marrow cells of Swiss albino mice

Pesticides are widely used throughout the world in agriculture to protect crops and in public health to control diseases. Glyphosate (N-(phosphonomethyl) glycine, $C_3H_8NO_5P$) constitutes one of the largest groups of herbicides sold in the world for control of annual and perennial plants including grasses, sedges, broad-leaved weeds, and woody plants. Nevertheless, exposure to pesticides can represent a threat not only to the environment but also to human populations exposed to them. Therefore, in the present study, genotoxic effects of the herbicide glyphosate (ispropyl amine salt of glyphosate 41%) were analysed by measuring chromosomal aberrations (CAs) and micronuclei (MN) in bone marrow cells of Swiss albino mice. Single dose of glyphosate was given orally to the animals at a concentration of 25 mg/kg bwt. and 50 mg/kg bwt. Animals of positive control group were injected intraperitoneally with benzo(a)pyrene (100 mg/kg bwt), a well known mutagen, whereas, mice of vehicle control received DMSO. Animals from all the groups were sacrificed at sampling times of 24, 48 and 72 h and their bone marrow tissue was analyzed for chromosomal damage. Glyphosate was found to significantly increase chromosomal aberration and micronuclei induction at both the tested concentrations and with an increase in exposure time in comparison to the negative control. The cytotoxic effects of glyphosate were also evident, as observed by significant decrease in mitotic index, when compared to vehicle control group. The study indicates that glyphosate has clastogenic and cytotoxic activity.

Assessment, mapping and remediation of groundwater in Kanpur region: A holistic approach

Studies were conducted to assess the groundwater quality in Kanpur industrial areas. A total number of 240 samples of groundwater were collected both from shallow and deep aquifers from the two major industrial areas (Panki and Jajmau) in Kanpur city and analysed for selected water quality variables and major classes of contaminants. The modeling based regional mapping indicated that both the shallow as well as deeper aquifers in industrial areas are considerably contaminated with various chemical contaminants.



Distribution (mg/l) of (a)NO_3-N in Jajmau aquifers (b)Cr in Jajmau aquifers (c)NO_3-N in shallow aquifers of Panki, (d) NO_3-N in deep aquifers of Panki, (e) Cr in shallow aquifers of Panki, and (f) Cr in deep aquifers of Panki.

Development of techniques and methodologies for exploration, assessment and management of groundwater in the hard rock areas

Studies were conducted to assess the anthropogenic pollution of groundwater in the alluvial geo-environment of Kanpur-Unnao-Lucknow region (UP). The nature and type of contaminants, their sources; soil-water interactions and subsequent mobilization of contaminants to groundwater aquifers; mass-transport modeling and associated health risk due to groundwater contamination has been explored to develop low cost methods for decontamination of water with reference to chemical contaminants. The study area was Unnao district of Uttar Pradesh, which lies in the northern Indo-Gangetic alluvial plains. Groundwater in this region is used for domestic, agricultural and industrial purposes. The soil, surface and groundwater (pre- and post-monsoon seasons) dataset of the study region covering an area of about 2150 km^2 was analyzed to understand soil-water interaction.

The seasonal variations and influences on groundwater hydrochemistry of the Indo-Gangetic alluvial region (Unnao area) were investigated through multi-way modeling approach. A three-way data set pertaining to hydrochemistry of the groundwater of north Indo-Gangetic alluvial plains was analyzed using three-way component analysis method. Three-way data modeling was performed using PARAFAC and Tucker3 models. The information obtained through Tucker3 model revealed that the groundwater quality in Khar watershed is mainly dominated by water hardness and related variables, whereas, water composition of the dug wells is dominated by alkalinity and carbonate/bicarbonates. Moreover, shallow groundwater sources in the region were contaminated with nitrate derived from fertilizers application in the region. The shallow aquifers were relatively more contaminated during the post-monsoon season.

Further, an extensive investigation of soil was conducted in the Jajmau area. The agricultural site (about 2100 acres), located at the outskirts of Kanpur, an industrial city, closely bounded by the Ganga River in the east is alluvium in nature. These soils are very fertile, probably due to irrigation with nutrient rich wastewater. The area is known for intensive agricultural practices. A total of 23 sites (20 in wastewater receiving area and 3 in non-receiving area) were selected in the region for soil sampling. Sites S1S3 are located in the area receiving no wastewater at all, whereas sites S4S23 are in area irrigated with wastewater. A systematic sampling was carried out collecting a total of 115 soil samples from 23 pits in the area. Soil samples were collected from each pit at five different depths: 05 cm (D1), 520 cm (D2), 2040 cm (D3), 4060 cm (D4) and 6080 cm (D5) layers. Soil samples were analyzed for selected characteristic properties and metals contents.

Data set of soils irrigated with wastewater was analyzed using two- and three-way PCA models to assess the soil/sub-soil contamination, and mobility of contaminants in soil profiles. Three-way data analysis was performed using PARAFAC and Tucker3 models validated for stability and goodness of fit. A two component PARAFAC model, explaining 36.23% of data variance, allowed interpretation of the data information. The first component was related with general characteristics of soils with little vertical variation, whereas the second component is related with the sites and depth contaminated with metals. The interpretation of core elements

(Tucker3) revealed interactions among components of different modes allowed inferring more realistic information about the contamination pattern of soils both along the horizontal and vertical coordinates as compared to traditional data analysis techniques. It was concluded that soils at sites closer to the wastewater outlet point are heavily contaminated with metals. Further, wastewater-related heavy metals confined to upper soil profiles are more accessible to the crop/vegetation plants grown in the region and their hyper-accumulation in edible parts of crops and fodder vegetation may pose risk to the consumers.

Multi-way partial least squares modeling of water quality data

The aim of the work was to demonstrate the application of multi-way partial least-squares (N-PLS) to the complex water quality data and how it can improve the interpretation of the results and the robustness of the model with respect to the traditional methods, such as unfold- PLS. The possibility of building a regression model correlating the primary water quality variables (independent) with their secondary attribute (dependent variable) was investigated. BOD of water was taken as the dependent variable. A database on surface water quality pertaining to a polluted river flowing through the northern Indo-Gangetic plains was selected. The study region witnessed extreme seasonal variations such as hot and dry summers (air temperature up to 49 ^{0}C), cold winters (air temperature up to 0 ^{0}C), and heavy rainfall during monsoon. Moreover, the river during its course received low to very high pollution load from various diffuse and point sources in its different stretches while flowing through urban townships, thus exhibiting very large variations in water quality variables. The sampling sites were selected from low, moderate and high polluted regions. The river water quality dataset is comprised of 19 water quality variables determined monthly at 8 different sites (S1-S8) over a period of 10 years. Both unfold-PLS and N-PLS (tri-PLS and quadri-PLS) regression methods have been applied in order to compare their performance in analyzing a large complex surface water quality data set and to evaluate their predictive capabilities as well as to investigate the time evolution of river water quality. The complete data set thus, comprised of 18, 240 observations. Here all the variables, except BOD constituted the independent data array, while, BOD as dependent data array set.

Surface water quality data set was analyzed using partial least squares (PLS) regression models. Both the unfold-PLS and N-PLS (tri-PLS and quadri-PLS) models were calibrated through leave-one out cross-validation method. These were applied to the multivariate, multi-way data array with a view to assess and compare their predictive capabilities for biochemical oxygen demand (BOD) of river water in terms of their relative mean squares error of cross-validation, prediction and variance captured. The sum of squares of residuals and leverages were computed and analyzed to identify the sites, variables, years and months which may have influence on the constructed model. Both the tri- and quadri-PLS models yielded relatively low validation error as compared to unfold-PLS and captured high variance in model. Moreover, both of these methods produced acceptable model precision and accuracy. In case of tri-PLS the root mean squares errors were 1.65 and 2.17 for calibration and prediction, respectively; whereas these were 2.58 and 1.09 for quadri-PLS. At a preliminary level it seems that BOD can be predicted but a different data arrangement is needed. Moreover, analysis of the scores and loadings plots of the N-PLS models could provide information on time evolution of the river water quality.

Multi-way modeling for heavy metal fractionation in sediments of alluvial river

This study presents application of multi-way modeling methods for analysis of the multi-way data set obtained through the sequential extraction procedure based fractionation of thirteen heavy metals/elements in three different particle sizes of the river bed sediments collected from ten different sites. The three-way (sampling sites, elements, particle size-bound elemental fractions) data set was analyzed using multi-way (three-way) component analysis method to evaluate the associations of heavy metals and their chemical fractions with the particle sizes of river sediments and their spatial distribution. A multi-way component analysis was performed using the Tucker3 model. The two-way PCA could not extract information about the behaviour of sampling sites and distribution pattern of metals with particle size. The three-way Tucker3 model applied to the three-dimensional data set allowed to visualize information about the three ways that could be interpreted jointly. The constructed three-way Tucker3 model (3,2,3) capturing about 46.34% of the data variance successfully provided in-depth information about the sampling sites, elements, particle size-bound elemental fractions and their distribution in different particle sizes of the river bed sediments. It also allowed the interpretation of the metals' fractionation data in all three modes.

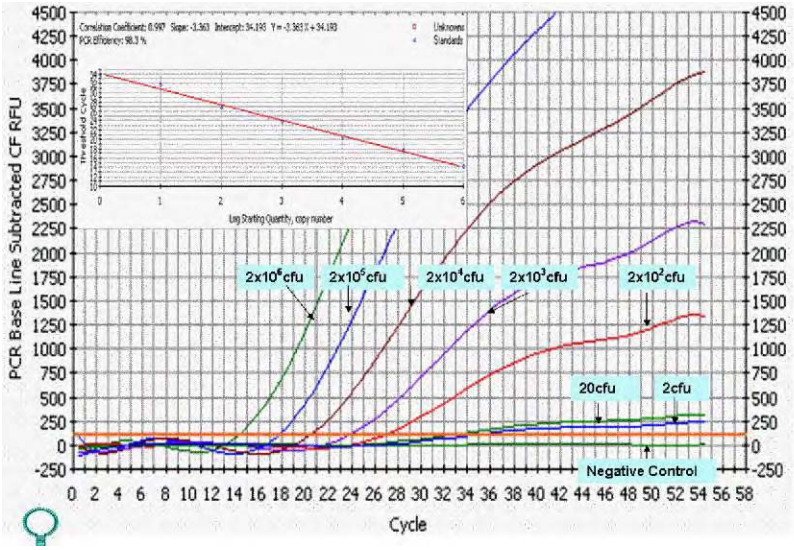
Prevalence of multi antimicrobial agent resistant toxin producing *Escherichia coli* in surface waters of the rivers Gomti and Ganga

The consumption of polluted surface water for domestic and recreational purposes by large populations in developing nations is a major cause of diarrhoeal disease-related mortality. River Ganga and its tributaries meet 40% of drinking and irrigation water requirements of India. In this study, *Escherichia coli* isolates (n = 75) of the river Ganga were investigated for resistance to antimicrobial agents (n=15) and virulence genes specific to shiga toxin (STEC) and enterotoxin producing *E. coli* (ETEC). *E. coli* isolates from the river water exhibit resistance to multiple antimicrobial agents. The distribution of antimicrobial agent resistance in *E. coli* varies significantly ($\chi 2$: 81.28 at df = 24, $p<0.001$) between the sites. Both *stx1* and *stx2* genes were present in 82.3% of STEC (n = 17) while remaining isolates possess either *stx1* (11.8%) or *stx2* (5.9%). The presence of *eaeA, hlyA* and *chuA* genes was observed in 70.6, 88.2 and 58.8% of STEC, respectively. Both *LT1* and *ST1* genes were positive in 66.7% of ETEC (n =15) while 33.3 % of isolates harbor only *LT1* gene. The prevalence of multi antimicrobial agent resistant *E. coli* in the river water pose increased risk of infections in human population.

E. coli isolates (n = 90) from surface water samples collected at six locations of the river Gomti were also characterized for their pathogenic potential as well as their sensitivity to antimicrobial agents using PCR and disk diffusion methods, respectively. In this study, 57.8 % of *E. coli* isolates exhibited resistance to 3 or more antimicrobial agents. Sensitivity to cephotaxime, gentamicin and norfloxacin was observed in 7.8, 48.9 and 77.8% of *isolates*, respectively. Both *stx1* and *stx2* genes were present in 15.6% of isolates while remaining isolates possess either *stx1* (17.8%) or *stx2* (6.7%). *stx1* gene (33.3%) was more prevalent than *stx2* (22.2%). *LT1* and *ST1* genes were positive in 21.2% of isolates.

Rapid detection of enterotoxicogenic *Escherichia coli* in water by using Molecular Beacon probe

Enterotoxicogenic *Escherichia coli* (ETEC) are regarded as a major cause of *E. coli* mediated diarrhoea worldwide in humans, affecting mainly children and travellers. ETEC also has important implications for the farming industry where it is a major pathogen of cattle and weaning piglets. The contamination of drinking or recreational waters with ETEC has been associated with water-borne disease outbreaks. In the developing world, an estimated 650 million cases of ETEC



Detection of Enterotoxicolgenic E. coli by Molecular Beacon (LT-1 gene)

infection occur each year, resulting in ~ 800,000 deaths mostly in young children. ETEC strains from humans cause mild or severe watery diarrhoea by producing a heat-labile enterotoxin (LTI), similar in structure to cholera toxin, heat-stable enterotoxins (ST Ia and/or ST Ib), or both. The LTs of *E. coli* are oligomeric toxins with two major serogroups LT-I and LT-II. LT-I is expressed by *E. coli* strains that are pathogenic for both humans and animals. We have earlier reported the presence of ETEC in surface waters of river Ganga and it's major tributary Gomti. The occurrence of potential ETEC in extensively used water resources is an important health concern as a large population depends on processed or unprocessed surface waters for drinking and domestic purposes. Hence, there is need for adequate monitoring technologies targeting pathogenic serotypes of microorganisms at low levels within hours or even in real time. Molecular Beacon, a Real-Time Polymerase Chain Reaction (PCR) probe was designed and evaluated for detection of ETEC (Figure 1). The probe targeted the most prevalent, *LT1* gene of ETEC in rivers, Gomti and Ganga. It can detect as low as 2 cfu of the reference strain. The probe was tested for surface water samples of river Gomti. ETEC levels were observed to be 100-1000 folds higher at recreational sites compared to upstream or downstream sites of river Gomti. The probe can be used for pre-emptive monitoring, water quality management and diagnostics of water-borne infections.

Removal of arsenic from water

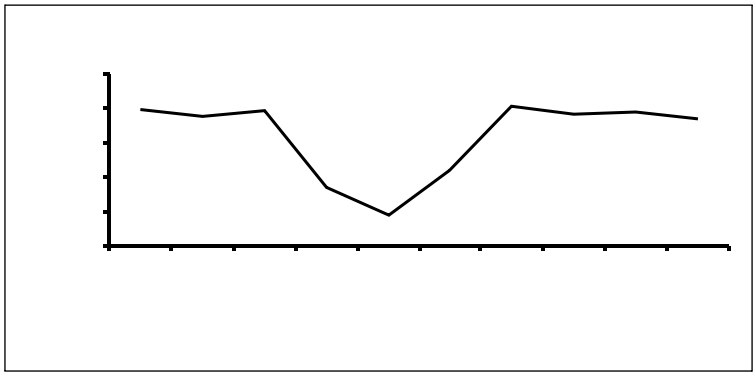
Iron hydroxide was prepared in the laboratory and adsorbed (coated) with coarse-sand. Iron (10 g) coated coarse sand was used for arsenic spiked (30, 50 or 100 ppb As) tap water to assess its removal capacity in 4 hours at pH 7.0. The arsenic decontamination efficiency of the adsorbent was concentration dependent. The removal efficiency was found to be 80-90% at 30 ppb level, 75-85% at 50 ppb level, and 60-70% at 100 ppb level arsenic spiked in tap water using fixed (10 g) amount of adsorbent. Studies are in progress to examine arsenic decontamination efficiency of iron coated coarse sand at different temperatures, pH and different time intervals.

Studies on use of indigenous minerals/natural products for the removal of heavy metals from drinking water

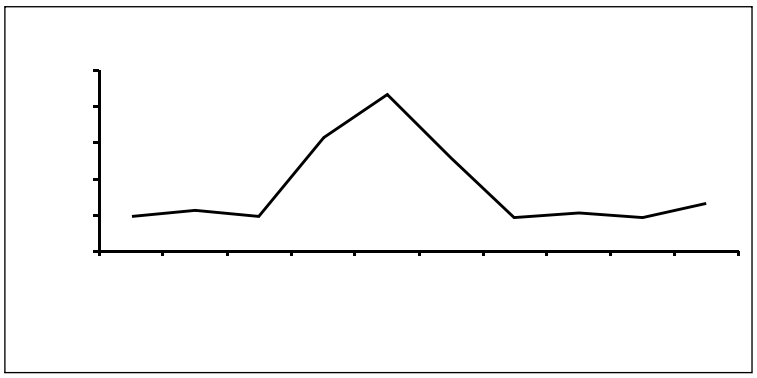
Industrialization poses risk to the pollution of water bodies through discharge of effluents that contain a number of chemicals including toxic metals. In order to make the polluted drinking water free from hexavalent chromium, studies were conducted using different adsorbents from indigenous minerals and natural products. They were coded as AdFS, AdFCS, AdAS, AdACS, AdAA, AdCS, AdG, AdSG, AdSS, AdHPG, AdZ, AdT, AdM, AdAB, AdCG and AdE. Suitable adsorbents were selected for the characterization and validation for the removal of hexavalent chromium and disinfection of drinking water in batch and column mode. The removal efficiencies of AdSG, AdE, AdSS were found to be above 90% at optimum conditions.

Assessment of the Gomti river quality

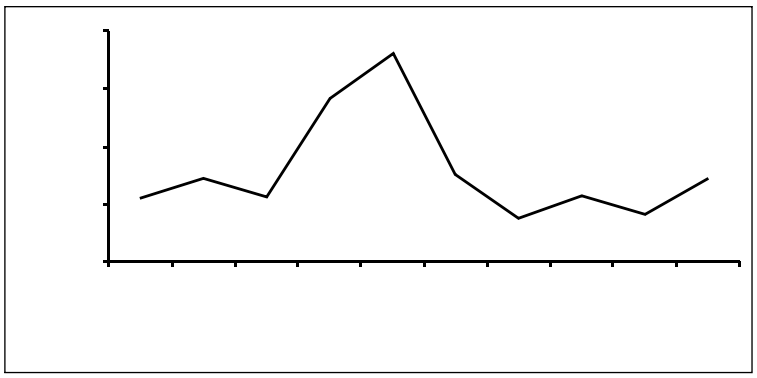
The water and sediments quality of the Gomti River was monitored at ten different locations between Neemsar and Jaunpur with a view to establish the baseline data for developing river pollution control strategies in the basin. The river water quality data generated during the period Jan. 2006-March 2007 revealed that river water quality deteriorates after it enters Lucknow city. The spatial variation plots of mean annual values of dissolved oxygen (DO), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in river water are presented in the figures. The river water quality improves through natural processes at Sultanpur. In the river stretch of about



Seasonal mean variation of Dissolved Oxygen (DO) in Gomti river water at different sites



Seasonal mean variation of Biological Oxygen Demand (BOD) in Gomti river water at different sites



Seasonal mean variation of Chemical Oxygen Demand (COD) in Gomti river water at different sites

40-50 kms, between Gaughat and Gangaganj, the river water quality is worst in terms of high BOD and COD, bacterial counts (MPN/100ml) and low DO as it receives huge untreated wastewater through drains and tributaries.

Drinking water quality surveillance in Lucknow city

Pre- and post-monsoon surveillances were performed during May and October, 2006 for bacteriological quality of drinking water from piped supplies and hand pumps in 20 locations of residential, commercial and industrial areas of the city. Pre-monsoon survey exhibited 33%, 40% and 47% of samples contaminated with >10 coliform and / or >1 faecal coliform /100 ml in residential, commercial and industrial areas, respectively (in view of standards fixed by BIS for drinking water). 48% piped supply and 26% of ground water samples were found bacteriologically unsafe. Post-monsoon survey result showed that 20%, 40% and 26% of samples were contaminated with >10 coliform and / or >1 faecal coliform/100 ml in residential, commercial and industrial areas, respectively. 30% piped supply and 8% of ground water samples were found bacteriologically unsafe. This surveillance dictates for proper disinfection and maintenance of drinking water sources in Lucknow city.

Industrial waste minimization and bioremediation

Sorption kinetics, leachability and bioavailability of heavy metals from the contaminated soil amended with immobilizing agent (humus soil and hydroxyapatite)

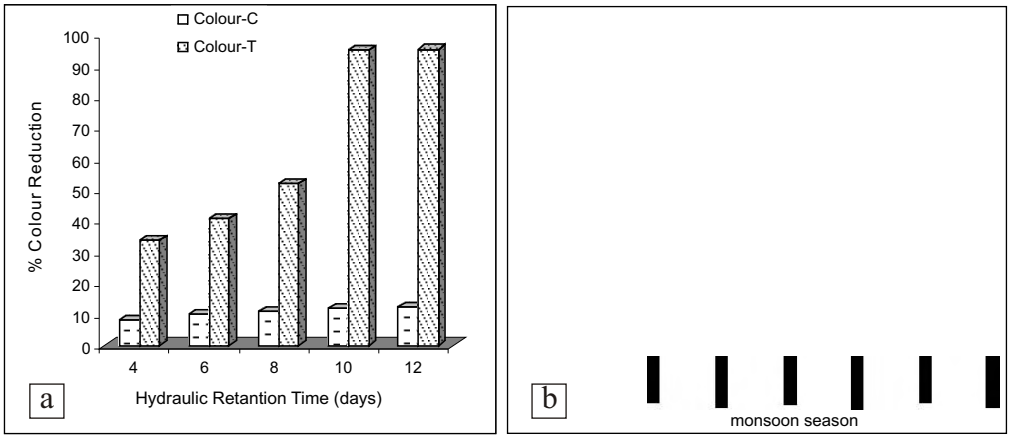
Metal containing waste released during the process of mining, manufacturing and disposal leads to the contamination of surrounding soil, adversely affecting environmental health. Studies were carried out in furtherance of our immobilization technique of heavy metals in contaminated soil using non-humus and humus soil and hydroxyapatite. The kinetics of sorption of heavy metals on the non-humus soil amended with (1:3) humus soil and 1% hydroxyapatite was studied. A batch equilibrium experiment was performed to evaluate metal sorption in the presence of 0.05M KNO_3 background electrolyte solutions. The Langmuir isotherms applied for sorption studies showed that the amount of metal sorbed on the amended soil decreased in the order of Pb^{+2}>Zn^{+2}>Cd^{+2}. The data suggested the possibility of immobilization of Pb due to sorption process and immobilization of Zn and Cd by other processes like co-precipitation and ion exchange. The sorption kinetics data showed the pseudo second order reaction kinetics rather than pseudo first order kinetics. Leachability study was performed at various pHs (ranging from 3-10). Leachability rate was slowest for the Pb^{+2} followed by $Zn^{+2}$and Cd^{+2}. Of the metals adsorbed on the soil, only 6.1-21.6% of Pb, 7.3-39% of Zn and 9.3-44.3% of Cd leached out from the amended soil.

Further, uptake bioavailability study using the Indian mustard plant (*Brassica juncea*) was undertaken at 7, 14 and 21 days intervals to test the immobilization of heavy metals from contaminated soil that were amended with humus soil and/or hydroxyapatite. For this, four sets consisting of non-humus soil + metals (Cd, Cr, Ni and Pb), humus soil + metals, non-humus and humus soil in the ratio of 1:3 + metals and non-humus soil: humus soil in the ratio of 1:3 + metals + 1% hydroxyapatite were prepared. The bioavailability of Pb, Cd, Cr and Ni in non-humus soil system was 58%, 67%, 65% and 63% respectively in 7 days, more than 80% in 14 days and more than 90% in 21 days. Use of non-humus, humus soil in the ratio of 1:3 and addition of 1% hydroxyapatite decreased the bioavailability of lead around 21 to 22.5%, Cd 35 to 36%, Cr 25.5 to 26.9%, Ni 34 to 39% in 7, 14 and 21 days. Apart from this, increase in the fresh weight of the plant was also noticed during the experiment. The data showed that addition of 1% hydroxyapatite in the non-humus-humus soil system caused around 90% increase in fresh weight in 7, 14 and 21 days as compared to plant grown in non-humus and metal soil system.

These studies showed that heavy metal immobilization technique for cleaning contaminated soil, using non-humus and humus soil and hydroxyapatite is a suitable technique to be used for industrial waste minimization and clean-up.

A technique for biological decolourisation of post-methanated distillery effluent in biphasic bacterial and wetland plant treatment system for environmental safety

A technique for decolourisation and detoxification of post-methanated distillery effluent (PMDE) was developed, using pilot scale constructed wetland system (i.e. area of 0.3 x3.0 x10^3 m^3) as a result of integration of bacterial pre-treated PMDE. The wetland system containing the mixed vegetation of *Phragmites cummunis* L., *Typha angustata* and *Cyperus oleocuperoides* showed reduction in colour (94.0 4.2), BOD



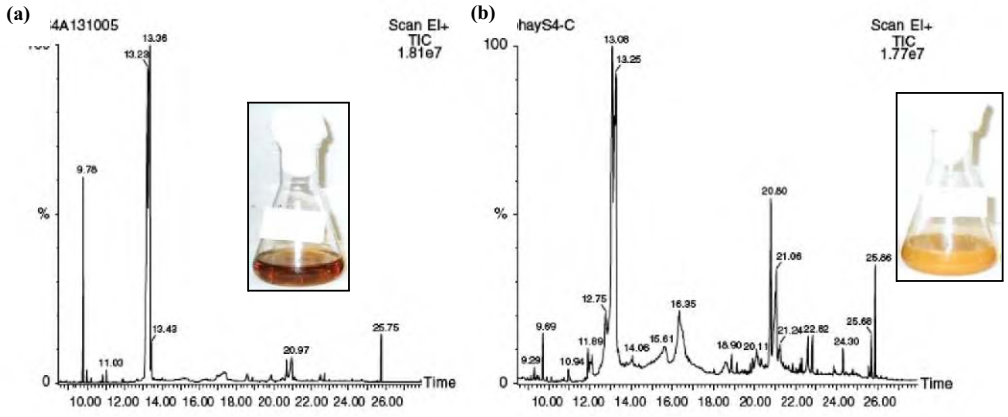
Percent colour reduction of PMDE at different hydraulic retention time (a) and changes in BOD and COD at different time intervals (b) of biphasic treatment system for distillery effluent.

(91.20 6.3), COD (90.0 7.0), TDS (90 6.1), TS (91.0 4.0), phenol (62 4.2) and sulphate (80 3.5) at the optimized condition which meets the recommended limit of effluent for environmental safety (Fig.). These findings concluded that bacterial treatment is essential prior to integration with wetland treatment system for decolourisation of PMDE, leading towards the development of a zero pollution discharge technique.

Biodegradation of kraft lignin by a newly isolated bacterial strain, *Aneurinibacillus aneurinilyticus* (AY856831) from the sludge of a pulp paper mill

A kraft lignin-degrading bacterium (ITRC S7) was isolated from sludge of pulp and paper mill and characterized as *Aneurinibacillus aneurinilyticus* (AY856831) by performing biochemical tests and 16S rRNA gene sequencing. The bacterium reduced the colour (58%) and lignin content (43%) from kraft lignin-mineral salt medium at optimized condition after 6 days as a result of co-metabolism of kraft lignin by *A. aneurinilyticus*. The analysis of lignin degraded products by GC-MS in ethyl acetate extract from an *A. aneurinilyticus*-inoculated sample revealed the formation of low molecular weight aromatic compounds such as guaiacol, acetoguaiacone, gallic acid and ferulic acid, indicating that the bacterium can oxidize the sinapylic (G units) and coniferylic (S units) alcohol units, which are the basic moieties that build the hardwood lignin structure (Fig. a, b). Among the identified

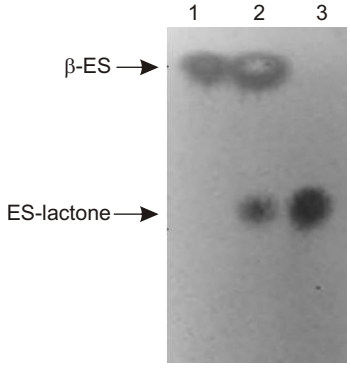
aromatic compounds, ferulic acid and 3,4,5-trimethoxy benzaldehyde could be useful to the industry as preservatives, aromas and perfumes.



(a) Total ion gas chromatogram of degraded kraft lignin (b) extracted from pulp & paper industry

In situ application of a bacterial strain for endosulfan degradation

The bacterial strain *Rhodococcus* sp. was isolated from the earthworm gut and its survival was studied with different concentrations of endosulfan. The optical density and CFU of the strain, grown in minimal media with endosulfan (sole carbon source) was increased with time (upto 10 days). Degradation of endosulfan by the isolated



TLC analysis of β-endosulfan degradation by a pure bacterium enriched from a soil from HIL, Cochin. Solvent system, Hexane: chloroform: acetone 1. Control2. Sample 3. Authentic ES-lactone

bacterium was observed by TLC/GLC. The free chloride released during incubation study showed a significant degradation of endosulfan, upto 80.9% and 92.6% at 10th and 15th day respectively; levels of isomers were significantly reduced within 5 days. A small quantity of endosulfan diol was detected in the samples.

Biomonitoring studies and health surveys

Bio-monitoring of polycyclic aromatic hydrocarbons in the blood of children residing in Lucknow (India)

Studies were conducted to assess the possible health risks due to Polycyclic Aromatic Hydrocarbons (PAHs) exposure among children. A bio-monitoring study was carried out in collaboration with Pediatrics Department, King George's Medical University (KGMU), Lucknow to determine PAHs levels in blood. Since variable composition of PAHs mixtures are emitted from different environmental sources, blood PAHs levels have been studied as per EPA priority list. On the basis of individual compound, median (50^{th} percentile) of naphthalene (19 ppb) was the highest, however benzo*(a)*pyrene (4.0 ppb) level was found to be the lowest among all detected PAHs. Median level of total non-carcinogenic PAHs (113.6 ppb) was found higher than the total carcinogenic PAHs (32.4 ppb) in blood samples of children. A significant correlation was found between time period spent in surrounding breathing zone of cooking place and total non-carcinogenic PAHs ($p<0.05$) level. Also, blood carcinogenic PAHs levels in children were found associated with their lower socio-economic status.

Toxicological implications of mercury exposure

Studies were conducted to examine the effect of pre and post-treatment with selenium in mercury intoxication. Selenium and mercury were given (20µmol/ kg b.w. each) intraperitoneally in mice and the effect on lipid peroxidation (LPO), glutathione (GSH) content, activities of superoxide dismutase (SOD), glutathione per-oxidase (GPx) and catalase (CAT) alongwith mercury concentration in liver, kidneys and brain were observed. No significant alteration in LPO and GSH content was observed in all the organs examined after mercury or selenium treatment alone. Pre-and post-administration of selenium resulted in a significant increase in the level of LPO and GSH. The activity of SOD was depleted by 40% in liver and in kidneys 74% compared to control group while that of GPx was lowered in liver 21% compared with control of mercury exposed animals. However, selenium administration resulted in restoration and depletion of these enzymatic activities. The activity of CAT in brain was significantly enhanced (57%) in Hg treatment compared with control and 82% in selenium treatment when compared with control. Administration of selenium significantly arrested enhanced CAT activity. Kidneys showed the highest mercury concentration (22.78 ppm) among the organs examined. Administration of selenium resulted in further enhancement of mercury concentration in the tissues. An increase in selenium level in liver was observed after mercury treatment, which was also restored by mercury selenium co-administration. The study suggests that the pro-oxidant effect of selenium was greater during pre-treatment.

Lipid metabolism in lead toxicity

The pathophysiological mechanisms involved in the lead-induced alterations are not completely understood. The distribution pattern of blood and organ lipids, as well as lipid metabolizing enzymes were investigated in rats exposed to 200, 300 or 400 ppm of lead through drinking water. Cholesterol and triglycerides in plasma and high density lipid (HDL) were significantly altered in control and lead exposed animals. The activity of paraoxonase, a key enzyme of lipid metabolism, was found to be significantly decreased in both plasma and kidney. The enzyme activity was not altered in brain and liver of the exposed animals. These results suggest that lead inhibits the secretions of paraoxonase from liver, thereby lowering the levels of the enzyme in plasma. The observed inhibition of secretion of paraoxonase from the liver and the decreased plasma activity of the enzyme might be an indicator for the onset of biochemical events.

Interaction of lead with some essential trace metals in the blood of anemic children from Lucknow, India

The presence of lead in human body adversely affects the hematological system due to inhibition of heme synthesis, leading to anemia. A cross-sectional study was conducted to evaluate the association of blood lead levels (BLLs) 10µg/dL, with anemia affecting the hematological system and some essential trace metals (iron, copper, zinc and calcium) in children. Multivariate analysis showed that children with BLLs 10µg/dL have 2.9 times more chances of having anemia as compared to children with BLLs <10µg/dL. The difference of adjusted mean values of selected hematological parameters and essential trace metals were significantly lower in children with BLLs 10µg/dL as compared to children with BLLs <10µg/dL. The elevated BLLs (10µg/dL) in children manifested significant association with the risk of anemia and influenced the status of essential trace metals.

Flow cytometric and cytogenetic analysis of cancer of cervix

Study was started with the aim to find out an effective and inexpensive cervical cancer marker which can be utilized to discriminate the high-risk cases in a cytological surveillance program. Women attending the OPD, Department of Obstetrics and Gynaecology, King George's Medical University (Lucknow, India), during the period of 2006 to 2007, were selected for the study. HPV-DNA detection by PCR and p53 and p-gp immunostaining were done in cytologically evaluated adequate cases of cervical dysplasia (n=142), atypical squamous cells of unknown significance (ASCUS, n=128) and normal (n=112). HPV-DNA of any type was detected in 25.7% (98/382) of cases. HPV16 was the predominant type and was seen in 14.9% (57/382), HPV18 in 5.3% (20/382) and other type in 5.5% (21/382) of cases. The intensity of immunoreactivity for p53 (nuclear expression) and p-gp (cytoplasmic expression) varied between different cytopathological grades of cervical smears. In cytological normal cases, only 8 cases showed >10-28% expression of p53. In ASCUS group 20% cases and in dysplasia group 58% cases were showing positive expression of p53 from mild to intense grade i.e. >15-54%. The expression of p53 was noted only in 30% cases of LSIL group whereas all cases

from HSIL group were showing positive reactivity to p53. In cytologically normal and ASCUS group, none was positive for p-gp expression. In dysplasia group, cases were showing positive expression of p-gp from weak to intense grade i.e. >10-27% in LSIL group (18% cases with weak and 4% cases with moderate expression) and >10-54% in HSIL group (8% cases with weak and 57% cases with moderate to high expression). A distinct correlation with expression pattern of p-gp and grades of dysplasia was noted. In conclusion, findings of the above study revealed diagnostic importance of studied parameters in differentiating the cytopathological conditions of cervix, by the expression intensity of both proteins and presence of high risk HPV.

Assessment of organochlorine pesticides residues in breast cancer patients

One hundred cases of women that were suffering from malignant or benign breast disease were identified. Their blood and breast tissues were collected and processed to monitor the level of organochlorine pesticides using gas chromatography equipped with electron capture detector. The α, β, γ, and δ isomers of hexachlorocyclohexane (HCH), and p, p` dichlorodiphenyldichloroethylene (p' p' DDE), most persistent metabolite of dichlorodiphenyltrichloroethane (DDT) were frequently detected in all the samples i.e. blood, tumor and fat. Total-HCH (71.1-234.6 ppb) and total-DDT (25.6-391.2 ppb) were found in the blood of the subjects. In tumor, range of total-HCH was 43.4-1885 ppb and total-DDT between 94.0-5906.4 ppb whereas in adipose tissue the range for total-HCH was between 145.1-5031.5 ppb and total-DDT between 1207.2-11253.7 ppb. These observations indicated the need for larger sample size to statistically correlate role of pesticide exposure to breast disease.

Association of body composition and cardiovascular risk factors among active and sedentary population of Lucknow using Bioelectric Impedance (BI) method

A cross sectional health survey was undertaken among the policemen of Lucknow for assessing their health status with special emphasis on their body composition. The survey included 1042 male policemen. Mean age (yrs), height (cms) and weight (kg) were 38.10 ± 10.03, 171.2 ± 7.42 and 72.36 ± 10.55 respectively. Percentage of overweight (BMI>= 25.0) among policemen was found to be 46.1 however obesity (BMI >= 30.0) was only 6.1 per cent. Visceral Fat Analysis showed high fat (VFA>=15) in 14.3 per cent policemen and slightly high (VFA between 10 to 14.9) visceral fat in 37.9 per cent subjects. Visceral fat was significantly increased ($p<0.001$) in higher age group (21.7 %) compared to lower age group (2.6 %). Prevalence of slightly high (BF % between 20 to 25%) and high body fat content (BF % >25) was 32.2 per cent and 45.6 per cent respectively. The prevalence of high fat content was found to be significantly increased ($p<0.001$) in higher age group (57.8 %) in comparison to lower age group (26.0 %). Morbidity pertaining to cardiovascular system was found to be 29.6%. Diastolic blood pressure was ≥ 90mmHg among 20% policemen while 11.8 per cent showed systolic blood pressure ≥ 140mmHg.The study shows that overweight and excess body fat percent leads to cardiovascular morbidity in policemen. Exercise such as walking and yoga may be taken as preventive measure.

Effect of tetra hydro-azadirachtin (THA-EC) on health record of spray operators

A total of 32 sprayers [16 (male 14, female 2)] and non-sprayers [16 (male 14, female 2)] were examined for clinical, cardio-vascular, neurological, haematological and biochemical parameters. After six months and twelve months studies, no adverse effects could be attributed to THA-EC exposure.

State of industrial hygiene and workers health hazards in bone-based industrial units

Lots of dust is generated during manufacture of bone-based ornamental and decorative items in the unorganized sector. State of industrial hygiene, health hazards to workers in these units is not known. A study was therefore conducted to monitor the profiles of airborne dust at work places of seven bone-based industrial units. Mean total suspended particulate matter TSPM, PM10, PM2.5 were in the range of 2.99-5.36, 0.375-1.126, 0.269-0.482 mg/m^3, respectively. *In vitro* toxicity of occupational dust was also carried out assessing their haemolytic and cytotoxic activities using concentrations 25-1000 g/ml. Interestingly, occupational dust samples collected from all the seven industrial units showed concentration-dependent as well as time-dependent haemolysis in red blood cells and cytotoxicity in rat hepatocytes. It was extrapolated from this initial study that occupational dust prevalent in air at work places of these industrial units may cause pulmonary toxicity to workers. Further studies are in progress.

Ecotoxicology and environmental monitoring

Studies on the bio-diversity of fish fauna in Ramgarh Lake, Gorakhpur

Studies were conducted to assess the environmental quality status and biodiversity pattern of fish population in Ramgarh Lake, Gorakhpur. The water quality of lake and biodiversity of fish fauna were monitored. Many of the surface water parameters were found to be above the permissible limits. Only 18 fin fishes were recorded out of 28 fin fishes reported in the past. Breeding pattern of most of the fishes of commercial value was observed to be significantly affected. Observations indicate deterioration of water quality as well as depletion of fish and plankton population. Treatment of sewage, removal of hydrophytes, restriction to exotic species, restricted commercial use, community participation etc. have been recommended in order to maintain the ecological balance in the lake. As such, maintenance of water quality and restoration of native species are required to be expedited in order to protect the natural state and biodiversity of lake.

Activity biomarkers in fishes for ecotoxicity assessment

Ecotoxicological risk associated with the exposure of heavy metals to ecosystem was investigated, taking into account various enzymatic and non-enzymatic antioxidants as biomarker of the heavy metal toxicity in fresh water fish *Heteropenustes fossilis*. Subacute exposure [(1/6 and 1/10 of LC_{50}) i.e. 84 µg/l (96 hr)] of arsenic (sodium arsenate) was found to increase the activity of catalase in liver and kidney of fish. However, glutathione peroxidase (GPx) activity was significantly reduced on exposure to arsenic which also reduced the levels of glutathione, an essential cofactor of GPx. The activity of lipid peroxidation and glutathione transferase was significantly increased, indicating arsenic induced oxidative stress.

Monitoring and evaluation of environmental parameters

The parameters for different environmental components viz; air (respirable suspended particulate matter, suspended particulate matter, sulphur dioxide, oxides of nitrogen etc.), meteorology (wind speed, wind direction, temperature, humidity, rainfall etc.), stack emission (particulate matter, sulphur dioxide, oxides of nitrogen etc.), water and effluent analysis (physicochemical, metal and bacteriological quality) and soil quality (mechanical, physicochemical and metals) were monitored. Besides the above common parameters, other parameters like hydrocarbon, carbon monoxide, PAH and mercury and noise level were monitored in some studies. The above parameters were monitored to assess the environmental quality in the following eleven projects :

1. Monitoring of Environmental Parameters of M/s. GAIL India Ltd ., PATA
2. Assessment of Ambient Air and Effluent Quality and Monitoring of Stack Emissions at M/s. Rihand Super Thermal Power Plant (RhSTPP), NTPC, Bijpur, Rihand, U.P.

3. Evaluation of Ambient Air Quality, Stack Emissions, Water and Wastewater of M/s. Anpara Thermal Power Station Anpara, Distt. Sonebhadra, U.P.
4. Assessment of Ambient Air and Effluent Quality and Monitoring of Stack Emissions at M/s. Singrauli Super Thermal Power Station (SSTPS), NTPC, Shaktinagar, U.P.
5. Environmental Monitoring for Stack Emission, Ambient Air Quality, Effluent Water Analysis and Sludge Analysis of M/s Hindaco Industries Limited. Renukoot, Sonebhadra, U.P.
6. Environmental Monitoring for Stack Emission, Ambient Air Quality, Effluent water analysis and sludge analysis of M/s Parichcha Thermal Power Plant, Parichcha, U.P.
7. Testing of Environmental Parameters of 2 x 200 MW Unit, Parichha Thermal Power Project, U.P.
8. Monitoring of Stack, Ambient Air, Analysis of Effluent of NTPC, Unchahar, U.P.
9. Testing and Monitoring of Stack Emission, Ambient Air Quality Monitoring and Water Effluent Testing of Panki Thermal Power Plant, Panki, Kanpur, U.P.
10 Monitoring of Process/ Stack Emission, Ambient Air Quality, Water/ Effluent, Soil and Sludge Quality of ITI Ltd., Mankapur
11. Monitoring of Environmental parameters of Renusagar Power Division of HINDALCO Industries, Renusagar

Assessment of impact of atmospheric emission from the proposed 10000 TCD Sugar Mill at Dhada, Bujurg, Kushinagar, Uttar Pradesh.

The objective of this study was to assess the impact of air pollutants on the proposed 500 feet Lord Buddha statue at Kushinagar which is 19 km away from the proposed project site of sugar mill. Under this project, work was carried out for the prediction of air pollutants viz; SPM, NOx, and CO due to proposed operation of 10000 TCD Sugar Mill. The assessment was conducted through mathematical modeling using ISCST3, Screen and Caline models.

Rapid Environmental Impact Assessment (REIA) for caustic soda membrane based plant of Kanoria Chemical Industries Limited, Renukoot, Sonebhadra, U.P.

Report on Rapid Environmental Impact Assessment (REIA) and Environmental Management Plan (EMP) for proposed expansion of 110 TPD Caustic soda plant based on state of art membrane based technology in the existing premises was prepared and presented before the appraisal committee of MoEF, New Delhi and environmental clearance accorded.

Assessment of environmental quality of Lucknow city, during pre-monsoon (May-June 2006) and post-monsoon (October-November, 2006).

Survey of air pollution in the Lucknow city was conducted during May- June 2006 and October-November 2006 representing pre-monsoon and post-monsoon period, respectively. The basic objective of these surveys is to create awareness in masses about the increasing trend urban pollution and to help the administrative agency to take remedial measures for the improvement of environmental conditions. The findings of the surveys were compiled in the form of reports and were released on 5th June, 2006 i.e. World Environment Day and 4th November, 2006, ITRC Foundation Day.

The surveys included study of air pollutants (SPM, RSPM, SO_2, NO_x, HCHO and Pb) and noise levels at twelve locations, comprising 4 residential, 5 commercial cum traffic and 1 industrial) areas. Sampling locations near traffic junctions have shown higher concentration of pollutants as compared to other areas. SPM and RSPM levels were found to be higher than the National Ambient Air Quality Standards (NAAQS) at residential and commercial areas. Since the removal of diesel operated tempos from the trunk roads and introduction of CNG tempos, significant reduction in the concentration of the SPM and RSPM was observed.

New Facilities

Protein Sequencing System

The Procise® cLC Protein Sequencing System is the most sensitive technology for N-terminal chemical protein sequencing providing the ability to routinely perform analyses at femtomole quantities of samples.

Procise 491 cLC Protein Sequencing System sequentially cleaves the amino acids from N-terminus of a protein or peptide. It separates and identifies the cleaved amino acids and further analyzes the data.

The main components of the system includes

1. Procise 491 Clc Protein Sequencer (The Sequencer)
2. ABI 140D Solvent Delivery System (The Pump)
3. Perkin Elmer Series 200 UV/VIS detection (The detector)
4. Dell Computer (Windows)

In Silico Facility

An *in silico* facility has been established at ITRC to help in predicting the toxicity of chemicals and drugs using QSAR approach. The software has an in built artificial intelligence module. It also has a statistical solution to the problem of directly calculating physical and biological properties of molecules from their physical

Prof. M.S. Valiathan, Chairman, Research Council, ITRC inaugurating the In Silico Facility. Also seen are Dr. C. M. Gupta, Director, ITRC and Dr. Alok Dhawan

structure. The information is extracted from a set of numerical descriptors characterizing molecular structure and this information helps in developing inductively a relationship between structure and property correlating to toxicity through the use of Neural networks, Pruning neural networks and kNN methods. Complete analysis of biomolecules, homology modeling, docking exercises, and identifying ligand interactions are carried out through the software.

Capabilities and Expertise

- A battery of toxicity tests studies as per the approved National and International guidelines.
- Analysis of polyaromatic hydrocarbons, dopamine, 3, 4-dihydroxy-phenylacetic acid, homovalenic acid, aldehydes and aromatic hydrocarbons in biological samples and different environmental matrices like air, water, river sediment and soil.
- Assay of benzene, toluene and xylene in blood, air and smoke samples by GC-MS.
- HPLC analysis of carcinogenic dyes.
- *In vitro* and *in vivo* test systems such as rat intestinal microorganisms, cell cultures, transgenic *Drosophila melanogaster* and *Bacopa monneri* for the evaluation of genotoxic, carcinogenic and mutagenic potential of xenobiotics and mechanistic studies.
- Carcinogen risk assessment capability using *in vitro* experimental model.
- *In vitro* assessment of xenobiotic metabolizing P450s in cultured rat brain neuronals and glial cells.
- *In vivo* genotoxicity assessment in multiple organs and tissues of mouse using alkaline comet assay.
- Receptor binding microassays by high throughput screens for neurological disorders.
- Oligomer designing for PCR and real time PCR to detect water and food borne-pathogens, genetically modified crops, genotyping studies.
- Monitoring of emission from biomedical incinenators.
- Pharmacopoeial standards for drugs of poisonous plant origin including their anatomical features and chromatographic finger print profile.
- Identification of specific medicinal plant ingredients using marker compounds by HPLC and HPTLC methods.
- Comparative antioxidant potential of medicinal plants using multiple semi-automated microassays.
- Development of 96 well microplate assay for assessing total antioxidant capacity of test sample using ABTS radical quenching.

- Technique for studying RAPD profile of medicinal plant samples collected from different ecological zones of India was standardized which included isolation of plant DNA and its amplification using gradient PCR.

- Expertise in the area of Multivariate Statistical Modeling and measurements uncertainty in chemical analysis.

- Expertise for calibration of pressure gauges, balances and spectrophotometers, pH meters, Conductivity Meters, Thermometers, BOD Incubators, Tachometer, Centrifuges, Wattmeter, Voltmeter, Current meter, KV Meter, Ratio meter, Current Transformer, Frequency meter, Multimeter Wheat stone Bridge, Kelvin Bridge, Clamp-on Meters.

- Flow cytometry for mechanistic studies at sub-cellular level.

- Application of advanced multi-way modeling through N-way partial least squares (N-PLS) to environmental data sets.

- *In vitro* assessment of heavy metals and antibiotics gastrointestinal-cellular toxicity in cultured rat intestinal epithelial cell line and gut bacteria.

Services Offered/Rendered

Health and Environmental Monitoring

- Epidemiological surveys on occupational diseases in industrial workers with suggestion for remedial measures.
- Surveys for adulteration and contamination of food material.
- Environmental monitoring at selected sites.
- Monitoring of noise level in industrial, commercial and residential areas.
- Environmental and ecotoxicological impact assessment studies.
- Analysis of serum samples of protein malnourished children for their antioxidant status.

Safety Evaluation

- Drinking and packaged water.
- Agrochemicals, dyes, food additives, plastics and polymers, petrochemicals, detergents, fibres and particulate matter.
- Herbal products and pesticides.

Toxicity Studies

- Long term toxicity studies for neurological, reproductive, teratogenic, mutagenic, carcinogenic and phototoxic evaluation of environmental chemicals/NCEs.
- Gastrointestinal toxicity evaluation of petroleum products (multi-functional additives) following oral and dermal exposure.
- GI-toxicity evaluation of extract of plastics in water/simulant.

Analysis of Pollutants and Quality Assurance

- Quality assurance for purity of herbal raw drugs and presence of contaminants.
- Analysis of residues of pesticides and metals in biological and environmental samples.
- Analysis of waste water from industries.

Disposal of Wastes

- Biodegradation of persistent pesticides and bioremediation of contaminated sites.

Information Services

- Electronic information database: Chembank, Poltox, Poisondex, IPCS-INTOX, ILO encyclopedia, CHEMWATCH
- Updated database (DABTOX) on toxicity profile of industrial chemicals/agrochemicals; food additives and cosmetics used in India.

Technical and Support services

Library and Toxicology Information Centre

A well established set up of Library attracts and encourages the scientists and research scholars of an institution to devote excitingly towards R&D activities. ITRC library tried to become a model Library through collection of rich literature encompassing state-of-the art information in the area of industrial and environmental toxicology. Presently, the Library is enriched with 31,000 information materials of different categories such as books, bound periodicals, databases, reports and specific reference material on print and electronic format. During the period library acquired 77 books, 556 bound periodicals, 64 ITRC Research Papers and 77 Annual Reports of different Institutions. Library subscribed to 113 periodicals. Full text access of 5000 periodicals of 13 biomedical publishers is available to all scientists on their desktop computer under CSIR E-journals consortium. Apart from this, ITRC also subscribes to four on-line journals directly from the publishers. Full text access of Bureau of Indian Standards database is provided to scientists on intranet.

Full text database of American Standards of Testing Material (ASTM), and two other international databases, CHEMBANK and POISINDEX are available on CD-ROM. The abstracting services, in-house bulletin and other current awareness services are also brought out. The staff of the library imparted training to two students of Diploma in Library and Information Science under Apprenticeship Act, 1961.

Research, Planning and Business Development

Research, Planning and Business Development Division (RPBD) is the central point to govern and project the overall activities of the centre by planning, monitoring and evaluating the in-house, networked and externally funded projects activities. It also explores the possibilities of business development by establishing liaison with industries, private and public sector undertakings, government organizations, research institutions and universities. Further, it interacts with International Scientific and Technology Affairs Directorate of CSIR and other International and National agencies to organize the visits/deputation of scientists under various bilateral exchange programmes. Preparation of annual scientific reports, five year plan, proper management of intellectual material by coordination with the scientists for identification of patentable content of the material and sending it to the Intellectual Property Management Division of CSIR for execution, are some of the important activities of the division. The R&D output of six major areas namely: Preventive Toxicology, Health Risk Assessment, Predictive Toxicology, Environmental Toxicology, Analytical Toxicology and Inhalation Toxicology are compiled, collated and published yearly in the form of Annual Report to apprise the industry, government and academia about the centre. The division is also responsible to attend to parliament questions, prepare audit replies and arrange meetings of Research Council (RC), Management Council (MC) and other activities related to extramural human resource development. In addition, the division facilitates signing of MOUs/Agreements between the institute and outside parties related to project

activities and training. The division also arranges training of postgraduate students from various universities and officials of national and international organizations.

Further, the division interacts with media to highlight various institutional programmes (National Technology Day, World Environment Day, CSIR/ITRC Foundation Day, Workshops, Seminars and Conferences) by making them accessible with their highlights and day to day R&D activities for proper coverage and publicity.

Biomedical Illustration and Photography

The division is well equipped with modern tools for projection and photography viz. computers, digital interactive screen, multimedia slides and overhead projectors, SLR and digital cameras to facilitate various activities of the institute. It also prepares posters and other display materials required for presentations. Facilities exist for developing and printing of black and white photographs and of coloured slides required for publication. The division organizes projection and plays important role in exhibition of our achievements at various locations in the country.

ENVIS Centre: A Distributed Information Centre on Toxic Chemicals

The ENVIS Centre, partly supported by the MoEF, Govt. of India has been functional at ITRC since the past 4 plan periods. The work carried out during the year 2006-07 is given below:

- Database on Toxic Chemicals Information related to 50 chemicals used as dyes and other industrial chemicals has been compiled and stored in the existing database. Updating of the existing information in our database is also carried out. Information on 20 chemicals has been updated.

- Publications
  a. Abstracts of Current Literature in Toxicology, Vol. 18, No.3-4 (Jan-June) 2006 with 180 abstracts and Vol. 18 No. 1-2 (July-Dec) 2006, with 200 abstracts pertaining to various environmental and toxicological topics have been compiled this year.
  b. Newsletter: A quarterly publication, ENVIS Newsletter is brought out regularly. Vol. 14, Nos. 3 & 4 and Vol. 15, No. 1 have been published this year.
  c. An annotated bibliography of Indian Literature on Arsenic (111 abstracts).
  d. Enviro Files: a compilation of newspaper clippings.

- Environmental Information: A total of 113 queries were processed and relevant information provided to users. Queries were mostly related to human health, industry, agriculture, chemistry and biochemical processes, and pollution & wastes.

- Website Management

The website is being maintained and following activities were undertaken:

1. Data entry of toxic chemicals is in progress and will soon be made available online.
2. Online information made available: Newsletter upto Feb. 2006. Archives since 2000; every month 15 to 20 abstracts of current literature in toxicology and environment added available since June 2000; Daily "Environmental News" added from newspapers, scientific magazines and journals. All ENVIS publications can be found on the website.

Computer Centre

Computer Centre provides central computing facility to the staff of the Institute engaged in R&D and other support activities. This facility includes development & maintenance of application softwares, web sites, and databases. The Computer Centre also provides intranet and internet facilities and maintains a campus wide Local Area Network consisting of more than 125 nodes. It also manages, monitors and coordinates 1Mbps broadband Internet connectivity. It maintains a central internet and DTP facilities which caters to the need of staff and students of the institute. This Centre also regularly provides in-house computer software training for human resource development. The Information & Communication Technologies infrastructure of the institute has recently been strengthened under the CSIR project on "Building a Scientific Knowledge Grid, ICT Infrastructure and Services for CSIR Laboratories".

Animal Facility

To compete in the international research and maintaining credibility of the toxicological testing, ITRC has established an animal facility that is running as per quality control norms. Rodents like mice, rat and guinea pigs and lagomorphs such as rabbits are maintained in the animal facility. The facility is managed by qualified veterinarians and supervised by the experienced technical staff.

During the year 2006-2007 ITRC animal facility sold animals to various institutions for thier research work and experimentations. Also, the facility has developed bio-pesticide evaluation unit for the toxicological data generation for industries engaged in production and marketing of new biopesticides.

Physico-mechanical, electrical and electronic standards

A new calibration laboratory was established under the network programme and reference standards were procured for the calibration of electrical and non-electrical parameters. Technical support is provided to different divisions/sections of ITRC by repairing and calibrating various equipments referred to this section, especially for the sections accredited by NABL. A total of 52 equipments were repaired during 2006-07.

Reference Standards were recalibrated from National Physical Laboratory and used for the calibration of AC/DC Voltage, AC/DC Current, Resistance,

Temperature, Revolution Per Minute (RPM), Pressure, weights & Wavelength of spectrophotometers. The Reference Standards recalibrated to maintain traceability to the National Standards are: Multifunction Calibrator, Make: Fluke, Model 5500A, Duel Well, Dry Well Temperature Calibrator, Make Fluke, Model 9011, Platinum Resistance Thermometer (PRT), Fluke, Model: 5626, Digital Temperature Readout, Fluke, Model: 1529, Standard Weights, Make Weight India with NPL Certification, Tachometer, Make Metravi, Model TM 4005

Analytical Chemistry Section

Analytical Chemistry Section extends centralized analytical facility and provides support services to the research activities of the institute. It is equipped with modern sophisticated equipments like Atomic Absorption Spectrometer (AAS), High Performance Liquid Chromatography (HPLC)., Gas Liquid Chromatography (GLC), -Scintillation counter, Gas Chromatograph-Mass Spectrometer (GC-MS). The section has capabilities for accurate and precise, determination of organochlorines, organophosphorous pesticides, pyrethroids, polyaromatic hydrocarbons, and heavy metals of toxicological interest in various matrices like plant/food, environmental and biological materials.

The technique SPME has also been utilized for the analysis of volatiles in biological samples. The technique integrates sampling, extraction, concentration and sample introduction in a single solvent-free step. Analytes in the sample are directly extracted and concentrated to the extraction fibre. The method saves preparation time and disposal costs and can improve detection limits.

Routine analysis of referred samples of biological/environmental origin are conducted for the determination of chemical pollutants/toxicants as per NABL guidelines. Arsenic evaluation studies in water samples of hand pumps sponsored by U.P. Jal Nigam, Lucknow were successfully completed. Also, analysis of blood, urine and water samples for pesticides and metals received from PGI, Chandigarh and Remote Sensing Application Centre, Lucknow and heavy metals analysis in fish, medicine samples referred by ICMR, New Delhi as desired by Andhra Pradesh High Court were completed. Studies are going on for the analysis of pheromones (air borne chemical substances that are secreted externally by animal urine, feces) in the samples of urine/cervical mucous of cows/buffaloes at different phases of estrous period in collaboration with IVRI, Izatnagar. In addition, samples of water and soil are also being analysed for pesticides including organochlorines and organophosphorous compounds as well as pyrethroids, mainly cypermethrin and fenvalerate, which are used as mosquito repellants.

The section renders analytical services to different projects both in-house and sponsored and is directly involved in various testing jobs, which together leads to reasonable fund generation for self support.

Human Resource Development

Workshop Organized on Safety Assessment of Genetically Modified (GM) Foods

ITRC organized a Workshop on "Safety Assessment of Genetically Modified (GM) Foods" from Sept. 25-29; 2006. The workshop was sponsored by ICMR/AGBIOS Inc. Canada and BCIL India, and co-ordinated by Dr S. K. Goel, Scientist, ITRC. The workshop was designed to provide an in-depth training on key issues that need to be addressed for safety assessment and regulation of foods derived

AT the inauguration of workshop on "Safety Assessment of Genetically Modified Foods" (L to R) Dr. S.K. Goel, Dr. R.B. Raizada, Dr. V. Muthuswamy, Dr. R. Tuli, Dr. V.P. Kamboj and Dr. Morven McLean.

from genetically modified plants inclusive of toxicology, allergenicity and nutrition issues. The faculty was from USA (Prof. Goodman) and Canada (Dr. Morven and Dr. Macanzie). The workshop was attended by 22 participants from different disciplines and was very informative as well as very interactive.

International Update on Basic and Clinical Neuroscience Advances

An International Update on Basic and Clinical Neuroscience Advances was organized by Industrial Toxicology Research Centre, Lucknow from December 17-20, 2006 on the occasion of the Silver Jubilee of Indian Academy of Neurosciences, a

premier academic body of the country. The conference was sponsored by national agencies and academic bodies including Council of Scientific and Industrial Research, Indian Council of Medical Research, Department of Science and Technology, Indian National Science Academy, The National Academy of Sciences, India. Federation of Asian and Oceanian Neuroscience Society (FAONS), an affiliate body of International Brain Research Organization (IBRO) also supported this scientific event.

Professor A. Surolia, Director, National Institute of Immunology, New Delhi was the Chief Guest on the occasion and inaugurated the conference. He discussed about Alzheimer's disease, a neurodegenerative disorder that is quite common and has affected significant population through out the globe. Professor Surolia discussed at length the basic mechanisms that are involved in the etiology of the disease. He said that hundreds of protein residues mingle inside the specific brain region(s) in the disease condition and defective folding and unfolding of protein may be responsible for the disease. He also said that chances of the disease increases with the advancing age. The later part of his address also included the therapeutic management of this neurodegenerative disease.

Professor Masao Ito from RIKEN Brain Science Institute, Japan delivered the Silver Jubilee Lecture on "The Role of the Cerebellum in Implicit Behavior". He said

Inaugural session of International Update on Basic and Clinical Neuroscience Advances in progress

that cerebellum plays an important role to control physical and mental activities. Implicit activities organized and carried out unconsciously govern a large portion of our life which is as important as consciously performed explicit activities. He elaborated on the intricate mechanisms in cerebellum that has characteristic synaptic

plasticity and long term depression. Prof. Ito also said that the cerebellar activities are yet to be understood as cerebellum may account for ones unconsciously performed behavior.

Professor PN Tandon, President, National Brain Research Centre, Manesar who is also the President of Indian Academy of Neurosciences presided over the function. Professor Tandon opined that neuroscience research is a continuum of study from the molecular to the behavioural level that encompasses the body of research directed towards understanding the molecular, cellular, intercellular processes mediated through electrochemical signals, in the nervous system, integrated to subserve behaviour. He said that the last two decades have witnessed an explosion of interest in the field primarily due to the advances in diverse disciplines like molecular biology, immunology, genetics, biotechnology on one hand and micro electronics, computers, and newer imaging techniques on the other. It has helped in understanding many interesting facets that were not known earlier. He said that global burden of brain diseases is significantly increasing and is expected to enhance further with increasing life expectancy. He said that the ultimate goal of neuroscience is to unravel the mysteries of the brain which is possible if we know the brain completely. This will also help us to protect the brain and treat the diseased brain. In his elegant lecture, Professor Tandon highlighted the strengths and resources in neuroscience research in the country and encouraged the young scientists to come forward and work on these challenging problems(s) with concerted efforts. He hoped that the day is not far when the scientists will recreate the human brain.

Students from various schools and colleges who attended a special interactive session with renowned scientists at the International Update on Basic and Clinical Neuroscience Advances

Dr Vinay K Khanna, Scientist and Organizing Secretary of this scientific event informed that there were about 290 participants. More than 35 scientists from abroad including those from Canada, Denmark, Hong Kong, Japan, Nepal, South Africa and USA also attended this conference.

Nine symposia as per following details were organized during the four day conference:

1. Neuropathogenesis of HIV-1 Dementia
2. Recent Advances in Neuroscience of Alcoholism
3. Cell Signaling Pathways in Neurodegeneration, Neuroregeneration and Neuroprotection
4. Cellular and Molecular Mechanisms in Neurotoxicity: Influence of Nanoparticles and Nanomaterials
5. Computational Neuroscience and Neuroimaging
6. Neuroactive Herbal Preparations
7. Advances in Pathogenesis and Management of Parkinson's Disease
8. Psychiatric Disorders: A Neurobiological Perspective
9. Molecular Mechanisms of Stroke and Trauma Induced Neuronal Death

Besides the symposia lectures, plenary lectures, special lectures, oral sessions, young scientist colloquium and award sessions were organized. Poster sessions were organized to encourage and provide opportunity to young neuroscientists to present their work and interact with the experts. Interaction of college students with the experts was also arranged to motivate the young brains to the fascinating area of neurosciences. Professor AK Mahapatra, Director, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow delivered the valedictory address. He said although technological breakthrough has advanced our understanding about the disease process, we have to go a long way to understand the molecular mechanisms for the treatment of such disorders. He appealed to the young researchers to focus their work on the emerging areas.

Training courses for Good Laboratory Practice (GLP)

More than 150 scientists, students, test facility personnel, regulatory personnel and prospective GLP-inspectors, in India and abroad, have been trained on OECD Principles of GLP and its implementation and monitoring towards global acceptability of data from non-clinical safety/toxicity studies. The training programmes included:

- First Meeting of WHO/TDR Network of GLP Trainers and provided GLP training to 65 Brazilian scientists at Rio-de-Janeiro, Brazil, June 4-9, 2006.
- "Training Programme on Good Laboratory Practice and Regulatory Issues", organized by Human Resource Development Centre (HRDC), (CSIR), Ghaziabad, on Aug. 31 to September 1, 2006
- "2nd GLP Training Course for Test Facilities", organized by National GLP Compliance Monitoring Authority, New Delhi, March 28-30, 2007.

Environmental awareness programmes for school children and teachers

- Popular lectures were held on Aug 3 & 4, 2006 for school children and teachers under the scheme "Faculty Training and Motivation and Adoption of Schools and Colleges by CSIR Labs" several awareness programmes were organized along with the two schools, (1) Municipal Girls' Inter College, and (2) Jawahar Navodaya Vidyalaya that have been adopted by ITRC.

- Film show and laboratory demonstration for 40 teachers of Jawahar Navodaya Vidyalayas of Uttar Pradesh and Uttaranchal were organised. CSIR's programme on "Faculty training, motivation and adoption of schools/colleges by CSIR labs" on August 02, 2006.
- A special session of interaction with neuroscientists organized for school children of classes XI & XII at 'International Update on Basic & Clinical Neuroscience Advances & XXIV Annual Conference of Indian Academy of Neurosciences' on Nov. 18, 2006
- Sept. 15, 2006: Lab visit and interaction with ITRC scientists was organized for 80 meritorious students (Class XI) from Jawahar Navodaya Vidyalayas.
- An essay competition for wards of CSIR staff (class VI-XII) on September 21, 2006 as part of CSIR Foundation Day celebrations.
- Microscopes, optical benches and water distillation units were gifted to the adopted schools i.e. Jawahar Navodaya Vidyalaya and Municipal Girls' Inter College in December 2006 under the above mentioned CSIR project.

Faculty Training and Motivation and Adoption of Schools and Colleges by CSIR Labs

Under the CSIR programme for motivating the students and teachers a group of 40 teachers (Senior and Middle level) of Jawahar Navodaya Vidyalaya from different districts of U.P. and Uttaranchal were invited to visit ITRC on 2nd August, 2006.

Teachers and students of Jawahar Navodaya Vidyalaya, Piparsand and Municipal Girls' Inter College, Lucknow. ITRC scientists gifting some scientific instruments under the HRDG-CSIR scheme "Faculty Training and Motivation and Adoption of Schools and Colleges by CSIR Labs"

To give an idea of the working at ITRC, a film showcasing the laboratories and the areas of work was shown in the morning to all the participants. Later in the day the visitors were divided into two groups of 20 each and were taken to a few laboratories where they were acquainted with some instruments and experiments. The teachers also interacted with the scientists of the respective sections visited viz. Herbal Medicine; Developmental Toxicology; Food Toxicology; and the Analytical Section.

Laboratory visit and interactive session with scientists of ITRC was organized for 80 Class X meritorious students of Jawahar Navodaya Vidyalaya. All the participants belonged to Navodaya Vidyalayas from the entire state of Uttar Pradesh.

As per the proposal of HRDG-CSIR to implement the upgradation of science laboratories of the adopted schools and colleges, several scientific instruments were

purchased and provided to them. The 2 adopted schools are :

(1) Jawahar Navodaya Vidyalaya, Piparsand

(2) Municipal Girls' Inter College, Lucknow.

On the 13th and 14th of December, 2006, Scientific instruments were handed over to the 2 adopted schools under the CSIR programme, "Faculty Training and Motivation and Adoption of Schools and Colleges by CSIR Labs."

Students from Classes XI and XII of Municipal Girls' Inter College attended an interactive session on Dec. 18, 2006 with renowned scientists in the field of neuroscience. This meeting of 25 students was held during the International Update on Basic and Clinical Neuroscience Advances and XXIV Annual Conference of Indian Academy of Neurosciences organized by ITRC at Scientific Convention Centre, Lucknow.

His Excellency the Governor of Jharkhand discusses environmental issues with Scientists

His Excellency Shri Syed Sibte Razi, Governor of Jharkhand wished to discuss the hazards encountered in asbestos, coal and iron-ore mines.A meeting was called at the Governor House, Lucknow on May 4, 2006. Dr. S.K. Rastogi, Dy. Director alongwith a team of scientists, Dr. Iqbal Ahmad, Mr. Neeraj Mathur, Dr. Mohan Das, Mr. B.D. Bhattacharji, Dr. Vipin Behari, Mohd Ashquin, were present during the discussions. The Governor was concerned about human and environmental health problems associated with asbestos mines, mills and industries in Jharkhand. Dr. Rastogi and Dr. Iqbal apprised him of the health problems associated with the exposure to occupational dusts in industries and related asbestos toxicity during different levels of mining, milling and manufacturing of asbestos-based products as well as the ecological impact.

Deputy Director Dr. S. K. Rastogi presenting a copy of Final Technical Report entitled "Environmental Monitoring and Ecological Impact Assessment of Asbestos" of the MoEF sponsored project to His Excellency, the Governor of Jharkhand

A copy of the recently completed project sponsored by MoEF(Govt of India), entitled "Environmental Monitoring and Ecological Impact Assessment of Asbestos" was also presented to the Governor by Dr. S.K. Rastogi alongwith a project on asbestos. The meeting was coordinated by Head, RPBD, ITRC, Mr. B.D. Bhattacharji and Governor's Principal Secretary Mr. Amit Khare, IAS.

World Environment Day 5th June, 2006

This year's World Environment Day theme was "Deserts and Desertification: Don't Desert Drylands"! Dr CM Gupta, Director ITRC while welcoming the chief guest, Shri Sudhir Kumar, IAS, Principal Secretary, Food & Civil Supplies, Govt. of UP, informed the gathering of how United Nations General assembly in 1972 launched the international environmental movement and inspired many nations to take up the cause of combatting the adverse impact of growing human and animal populations. He also said that because of finite land and water resources, India embarked upon a national policy to bring 33% of the country's land area under forest cover. Implementation of desert and drought-prone area development programmes that include sand dune stabilization, wind erosion control soil and water conservation in peninsular India and river valley projects, watershed development, agro-forestry, social forestry and joint forest management, salinity control, through state land development departments, forest departments, R&D institutions, NGOs, and people's participation are necessary.

Dr CM Gupta released the Report on "An Assessment of Environmental Status of Lucknow-Pre-monsoon 2006". While presenting the report, Dr SK Bhargava, Head Environment Monitoring informed that the above study was conducted during the

Dr C.M. Gupta, Director, ITRC planting a sapling in Gheru campus on World Environment Day

month of May, 2006 for the assessment of air quality status with respect to SPM, RSPM, Fine Particle (PM2.5), SO_2, NOx, aldehyde and Pb, and the noise monitoring

at 11 locations (4 for residential area, 5 for industrial area, and 1 for industrial and 1 adjoining village area). Water quality of drinking water (piped supply and ground water) with respect to bacteriological examination i.e., coliform and faecal coliform was also carried out on 100 water samples collected from residential , commercial and industrial areas.

Later Shri Sudhir Kumar released the in-house news letter "Industrial Toxicology Bulletin and Proceedings of International Hindi Sangoshti "Paryavaran Evam Swasthaya: Javprodyogiki Ke Bardhte Kadam".

In his presidential address Shri Sudhir Kumar said that massive poverty in the developing countries constitutes one of the most important causes of environmental degradation, and until poverty is eradicated, sustainable development would remain an unachievable ideal.

World Environment Day celebrations: children participating in a painting competition (top); and the proud winners with their trophies (bottom).

Earlier on June 1, 2006 a painting competition for children (age group 5-15 years) was organized. Fifty one children participated. The participating children were divided in two groups, Junior (age 5-10 years) and Senior (age 11-15). The prizes were given to the winners of the competition. Er AH Khan convener of the programme proposed the vote of thanks.

Dr CM Gupta releasing the Report on "An Assessment of Environmental Status of Lucknow-Pre-monsoon 2006" on the occasion of World Environment Day.

हिन्दी पखवाड़ा

औद्योगिक विषविज्ञान अनुसंधान केन्द्र (आई.टी.आर.सी.) लखनऊ में दिनांक 14.09.2006 को हिन्दी पखवाड़ा 14 से 28 सितम्बर, 2006 के उद्घाटन समारोह का आयोजन किया गया। मुख्य अतिथि श्री गुलाब चन्द, निदेशक, आकाशवाणी, लखनऊ का श्री तारिक कुतबुद्दीन, वरिष्ठ प्रशासन नियंत्रक ने स्वागत किया तथा उनका औपचारिक परिचय दिया। उन्होंने कहा कि हिन्दी पखवाड़े के अन्तर्गत विभिन्न प्रतियोगिताओं का आयोजन किया जायेगा तथा प्रतियोगिताओं में भाग लेने वाले विजयी प्रतिभागियों को पुरस्कृत किया जायेगा। मुख्य अतिथि श्री गुलाब चन्द ने बताया कि हम लोग पूरे वर्ष हिन्दी में काम करते हैं तथा हिन्दी में बात करते हैं फिर भी हिन्दी पखवाड़ा मनाते हैं, ऐसा क्यों? हिन्दी के प्रयोग के लिए आप खुद विचार करें कि हम, कहाँ हैं? हमारी भाषा का व्याकरण ही हिन्दी के प्रगामी प्रयोग को बढ़ावा देने की प्रेरणा देता है। अनुवाद के क्षेत्र में भी हिन्दी भाषा ही सुयोग्य भाषा है। हिन्दी का विकास तभी हो सकता है जब हम इसे समझे और दूसरों को भी समझायें। मुख्य अतिथि ने हिन्दी पखवाड़ा की उत्पत्ति के विषय में विस्तृत जानकारी दी। उन्होंने बताया कि हम लोग अपनी ही भाषा के प्रति लापरवाह हैं इसलिए गलत शब्दों का प्रयोग होता रहता है। जब तक लोग हिन्दी का महत्व नहीं समझेंगे तब तक हिन्दी का पूर्ण विकास नहीं हो सकता है। हमें इसके विकास के लिए संकल्प करना चाहिए तथा कुछ न कुछ करते रहना चाहिए। इस अवसर पर मुख्य अतिथि को प्रतीक चिन्ह् भेट करते हुए कार्यक्रम के

अध्यक्ष और वरिष्ठतम वैज्ञानिक डॉ. अश्वनी कुमार ने कहा कि भाषा की शुद्धता की ओर ध्यान देना चाहिए। डॉ. अश्वनी कुमार ने मुख्य अतिथि तथा उपस्थित सभी का स्वागत किया तथा बताया की जहाँ पर गलत शब्दों का प्रयोग हो उसे सुधारना अत्यंत आवश्यक है। हिन्दी के विकास के लिए इसका प्रयोग करना अति आवश्यक है। श्री तारिक कुतबुद्दीन, वरिष्ठ प्रशासन नियंत्रक एवं समारोह के आयोजन सचिव ने केन्द्र के सभी लोगों से आग्रह किया कि इस पखवाड़े के दौरान

हिन्दी पखवाड़ा के उद्घाटन समारोह के अवसर पर मंच पर आसीन (बाये से दाये) श्री प्रदीप कुमार, डॉ. अश्वनी कुमार, श्री गुलाब चन्द व श्री तारिक कुतबुद्दीन

आयोजित विभिन्न प्रतियोगिताओं में बढ़-चढ़ कर प्रतिभागिता करें। साथ ही उन्होंने सभी के प्रति आभार व्यक्त किया। पखवाड़े में वाद-विवाद, आशुभाषण, लेख, टिप्पणी व मसौदा लेखन, हिन्दी आशुलिपी/टंक्कण एवं क्विज प्रतियोगिताओं का आयोजन किया गया।

पुरस्कार वितरण एवं समापन समारोह का आयोजन दिनांक 28.09.2006 को हुआ। इस अवसर पर मुख्य अतिथि डॉ. सूर्य प्रसाद दिक्षित, भूतपूर्व विभागाध्यक्ष, हिन्दी विभाग, लखनऊ विश्वविद्यालय ने कहा कि भाषा का उत्थान सभी भाषाओं को प्रयोग में लाने से होता है। भाषा संप्रेषण का माध्यम होता है। तथ्य एक होता है किन्तु नजरिया अलग-अलग होता है। आपका संस्थान विज्ञान को हिन्दी में लिखने का अच्छा प्रयास कर रहा है। भाषा के क्षेत्र में हम अपेक्षित लक्ष्य प्राप्त नहीं कर पाये हैं। किन्तु ऐसी स्थिति अन्य क्षेत्रों में भी है केवल भाषा को दोष नहीं देना चाहिए।

कार्यक्रम की अध्यक्षता करते हुये केन्द्र के वरिष्ठतम वैज्ञानिक डॉ. अश्वनी कुमार ने मुख्य अतिथि को प्रतीक चिन्ह् भेट किया। उन्होंने कहा कि प्रतियोगिता में भाग लेना एक सराहनीय कार्य हैं। उन्होंने प्रतियोगिता के आयोजकों को सहयोग हेतु धन्यवाद दिया। उन्होंने कहा कि मेरा विश्वास है आने वाले समय में हिन्दी का उत्तरोत्तर विकास होगा। इस अवसर पर पखवाड़े में

आयोजित विभिन्न प्रतियोगिताओं के विजयी प्रतिभागियों और हिन्दी में कार्य करने हेतु प्रोत्साहन योजना के अन्तर्गत केन्द्र के कर्मियों को मुख्य अतिथि ने पुरस्कार और प्रमाण-पत्र प्रदान किया गया। समारोह के आयोजन सचिव श्री तारिक कुतबुद्दीन, वरिष्ठ प्रशासक नियंत्रक ने कार्यक्रम

विज्ञान जागरुकता कार्यक्रम के अन्तर्गत पुरस्कृत छात्रों के साथ डॉ. राजकुमार उप्रेती, डॉ. गुरू तथा डॉ. वीरेन्द्र मिश्रा

के आयोजन हेतु सभी संबन्धित विभागों के सहयोग हेतु हृदय से आभार प्रकट किया और विश्वास व्यक्त किया की इस संस्थान में हिन्दी की वर्तमान प्रगति के आधार पर हम शीघ्र ही निर्धारित लक्ष्यों को प्राप्त कर लेगें।

CSIR Foundation Day

Team Lucknow CSIR, consisting of all the four laboratories ITRC, CDRI, CIMAP and NBRI jointly celebrated CSIR Foundation Day on September 26, 2006. The function included:

Prof. R.B. Singh, Member, National Commssion of Farmers, New Delhi. delivering a talk and (bottom) school children visiting a stall at the 'science exhibition' of Team CSIR, Lucknow, on the occasion of CSIR Foundation Day.

(a) A scientific lecture entitled "Structure determination of myco-bacterial proteins and its possible implications for combating TB" by Prof. M. Vijayan Hon. Prof. and distinguished biotechnologist, Indian Institute of Science, Bangalore at the Scientific Convention Centre,Lucknow.

Dr. Ashwani Kumar, Chairman organising committee speaking on the occasion of CSIR Foundation Day. Also seen are Dr. C.M. Gupta, Director, ITRC and Dr. R.K. Upreti, Convener, Organising Committee.

Dr. Kailash Khulbe explaining institute's achievements to school children during the exhibition held on CSIR Foundation Day.

(b) A joint exhibition of 'scientific activities of Team CSIR, Lucknow at ITRC lawns: More than 1000 students from various schools and colleges of Lucknow showed keen interest in the exhibits and interacted with the scientists of the four labs.

(c) A function was held where staff of ITRC who had completed 25 years of service and also those who had superannuated were honored by Dr. C.M. Gupta, Director, ITRC. Dr. Gupta also awarded prizes to the children who had participated in an essay competition.

(d) A health camp organized by the Epidemiology Section of ITRC: One hundred and twenty seven persons participated in the camp. Scientists monitored the body composition viz., Body Mass Index (BMI), Body Fat %, Visceral Fat Level and Basal Metabolic Rate by using Body fat analyzer based on the principle of bioelectric impedance analysis.

The report was given to the visitors who were also advised to maintain proper diet and perform physical activity to maintain BMI, Body fat % and Visceral Fat Level.

ITRC celebrates 41st Foundation Day

Industrial Toxicology Research Centre (ITRC) celebrated the 41st Foundation day on November 4, 2006. On this occasion the 10th Prof S.H. Zaidi oration entitled "Environmental health: challenges and opportunities" was delivered by Prof. PK

Prof. Hari Gautam, Vice Chancellor, KGMU lighting the ceremonial lamp during Prof. S. H. Zaidi Oration; (bottom) Prof P. K. Seth, CEO, Biotech Park (second from left) delivered the oration and Prof. Hari Gautam presided over.

Seth, CEO, Biotech Park, Lucknow. Dr Seth informed that environmental health is a major concern today, as a number of ailments like respiratory and cardiovascular disorders, neurological disturbances; reproductive and immune dysfunctions,

developmental defects and cancer have been linked to chemical exposure and environmental factors. The external genetic makeup and pre-existing infections also

At the ITRC Foundation Day Function: Seated (L-R) Dr. D. K. Saxena, Dy. Director, ITRC; Prof. A. K. Mahapatra, Director, SGPGI; Dr. T. Ramasami, Secretary, DST, New Delhi.

influences the outcome of exposure to chemicals. With the availability of stem cells, one can develop liver and other organs and use them for studying the mechanism of toxicity of chemicals and toxicity potential of chemicals as well.

Prof. Hari Gautam, Vice Chancellor, King George's Medical University, Lucknow in his presidential address, while appreciating Prof Seth's lecture, added that such lectures should be organized at KGMU so that the faculty and staff of his centre are benefited. Dr Poonam Kakkar, Scientist ITRC proposed the vote of thanks.

Later, in the afternoon the Foundation Day programme was held. Dr CM Gupta, Director, ITRC welcomed the Chief Guest, Dr T Ramasami, Secretary, Department of Science and Technology, New Delhi, Prof. AK Mahapatra, Director, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, and other distinguished guests. While presenting a brief account of the achievements of the Centre during the last one year, he said that in addition to the on-going networked and externally funded projects, the Research Council of the Centre has approved five new areas, namely, Systems Toxicology and Risk Assessment, Environmental Toxicology, Toxicogenomics and Predictive Toxicology, Food Drug and Chemical Toxicology and Assessment, Mapping and Remediation of Groundwater in Kanpur region.

He further said that ITRC has developed the facility for detection (as low as 0.1% of GM concentration) of two genetically modified (GM) crops, RR Soybean and Maize as by using PCR. Transgenic protein in the range of nanogram can be detected by indirect ELISA assay. Scientifically validated herbal formulations are being developed for antioxidant, neuroactive and anti hyperlipedemic activities. These are

Dr. C. M. Gupta, Director ITRC; and (Rt) Director presenting the Annual Report.

A view of the audience on ITRC Foundation Day

being further developed by Nicholas Piramal as Positive Health Promoters (PHP) under GMP norms.

In his Foundation Day address, Dr T Ramasami traced the history of ITRC and lauded the vision of those who thought of establishing a centre of toxicology because the country was moving from an agro-based to an industrial economy. ITRC having crossed 41 milestones, he hoped that by the fiftieth year ITRC would be partnering with various industries in several areas of toxicology.

Dr Ramasami released the "Annual Report 2005-06" of the centre and a report entitled "Assessment of environmental status of Lucknow city: A post-monsoon survey".

In his presidential address, Prof. AK Mahapatra, Director, SGPGI, Lucknow he appreciated the role of ITRC in preventive toxicology by undertaking various mission programmes for the benefit of the society. He also emphasized on the need to establishing toxicologist-clinician partnership.

On this occasion Prof Mahapatra released the in-house Rajbhasha patrika entitled "Vish Vigyan Sandesh". Dr DK Saxena, Chairman, Organising Committee proposed the vote of thanks

CSIR Programme on Youth for Leadership in Science (CPYLS)

On the 6th and 7th of February, 2007, Industrial Toxicology Research Centre organized the CSIR Programme on Youth for Leadership in Science (CPYLS). Five students from the top 50 merit holders of U.P. Board, CBSE and ICSE Boards' class X

CPYLS participants seen interacting with scientists and other staff members in the Petroleum Toxicology Lab (top), and at ENVIS Centre (bottom).

examination of 2006 participated in the programme held at ITRC. Out of these five students, four of them Devesh Rajan, Prateek Kushwaha, Manish Kumar Vishwakarma and Ashish Singh were from B.N.S.D. Shiksha Niketan, Kanpur, whereas Archit Tripathi was studying at City Montessori Inter College, Lucknow. All the children belonged to the mathematics stream.

At the inauguration of the CPYLS programme, Dr DK Saxena, Scientist and Chairman HRDC of the institute, welcomed the students, their parents and the Chief Guest, and emphasized on the importance of scientific knowledge for the growth of the country. While presenting the genesis of the programme he informed the gathering about the need of such a programme that was basically meant to encourage class X students to continue their scientific pursuits and interest in science as they prepare for college. The chief guest Prof. Pradip Sinha, Head, Biosciences & Bioengineering, IIT-Kanpur delivered a popular lecture entitled 'Selling Dreams in the Bio-space'. Prof. Sinha explained explicitly the amalgamation of all sciences that is mathematics, physics, chemistry and biology. He said that since most of the discoveries in the earlier times were related to physical sciences, now in this 'century of biology' there was ample scope in biological sciences. The students were introduced to several new and upcoming fields such as, Computational Biology, Biomechanics, Tissue Engineering, and Biomimetics. Stating that science is an ocean of knowledge and that, as no boundaries exist between biological and physical sciences, anybody working diligently and patiently could achieve his dreams. He lauded the efforts of CSIR in popularizing science among the students through CPYLS programme and providing motivation at the right time by "catching them young". Dr FN Jaffery, Convener of the programme, proposed a vote of thanks.

Further, a 2-day programme was chalked out for the students to visit various Institutional laboratories and facilities so that they could interact with the scientists. This exercise was carried out in order to acquaint the students with the modern approach to toxicology at molecular and genetic levels and also the impact of toxicants and pollutants on human health with modern tools. Techniques for detecting and quantifying chemicals and toxicants were shown in the Dyes & Food Adulterants Lab, Developmental Toxicology and the Analytical and Petroleum Toxicology Labs. The application of proteomics; Polymerase Chain Reaction (PCR) technique and its applicability in biological research; and microassays for high throughput screening of antioxidant potential of natural products were demonstrated to the students. The first day activities concluded with a talk on 'Modeling in Biotechnology' by Dr DK Chowdhuri, Scientist at ITRC.

On the next day, the Herbal Research, Environmental Monitoring Lab, Cell and Tissue Culture facilities, assessment of the impact of chemicals on growing embryos, and protocols for assessing the impact of occupational hazards on workers was demonstrated to the children. They were also taken round the library and digital library facility where the students participated in a Science Olympiad. Students were also familiarized with 'nanotechnology' via an animated talk delivered by Dr Alok Dhawan, scientist of the institute.

A valedictory function was held later in the evening where the students expressed their views and experience at ITRC. The children were quite impressed by the working facilities available here; the instruments and techniques particularly in the environmental toxicology, cell culture, and proteomics laboratories fascinated them most. While airing their opinions, the students expressed their satisfaction and gratitude towards CSIR's programme which has been beneficial to them in a way that in spite of all being students of mathematics stream, they were unanimous in stating that they would pursue a career in one of the newer biological sciences. The Director,

Dr CM Gupta also inspired them by quoting examples of several renowned biologists who shifted their career from physical sciences. The programme concluded with Dr Gupta presenting a memento, letter of appreciation and certificate of participation to the students.

National Science Day

National Science Day was celebrated at Industrial Toxicology Research Centre on February 28, 2007. About 150 students from schools and colleges participated in the programme. A film on ITRC entitled "Battling the toxicants" was shown to the teachers and students. The day was celebrated to enable the students and common man to interact with scientists. Later in the day, a function was held wherein Dr. Ashwani Kumar, Dy Director and Chairman of the programme welcomed the guests and students. In his address, Dr Ashwani Kumar said that students were ambassadors of the scientific community and through them the scientific activities carried out in the laboratories were disseminated to the masses.

Seated on the dais (L-R): Dr. A. K. Saxena, Dr. Ashwani Kumar & Dr. Poonam Kakkar.

Later a scientists-students meet was organized in which the students put up a number of queries to the scientists. Mr. Shukla, a teacher from Navyug Radiance School shared his view on ITRC's efforts to popularize science. In response to queries from students, Dr. Poonam Kakkar, Convener of the programme informed that Lucknow is the hub of scientific activities with four CSIR laboratories, Sanjay Gandhi Post Graduate Institute of Medical Sciences, King George's Medical University, Dental University, Biotech Park and various other engineering and dental colleges. She also briefed the students about research opportunities and the ongoing programme of ITRC regarding creation of scientific and environmental awareness for school children.

Seminars

Sl. No.	Name of Speaker	Topic
1.	Abhai Kumar	Polyaromatic hydrocarbons, nitric oxide and polymorphonuclear leukocytes
2.	Abhishek Ojha	Development of sensitive and rapid enzyme linked immunoassay for GM food detection
3.	Amita Mishra	GM crops: allergenicity assessment
4.	Amrita Malik	Assessment of groundwater contamination in Northern Indo-Gangetic alluvium region
5.	Anwar J Khan	Blood lymphocytes cytochrome P450 2E1 as a biomarker of alcoholic liver cirrhosis
6.	Ashima Sinha	Parkinson's Disease and biomarker development
7.	Chandra Kumar Singh	GMO's detection: dilemma & challenges for researchers-a case study of Bt-maize ($MON8_{10}$)
8.	Chandra Shekhar Seth	Studies on the accumulation of Pb and its toxicity to Indian Mustard (*Brassica juncea L.*)
9.	Divya Gupta	Identification of proteomic biomarker of lead exposure
10.	Dr Narendra Tuteja	DNA unwinding enzymes as molecular motors: role in disease and development
11.	Dwaipayan Sinha	Studies to evaluate anatomical characteristics and chemical constituents of bark of *Pinus roxburghii* Sarg. collected from eastern & western Himalayas
12.	Hifzur Siddique	Genotoxicity assessment of industrial solid waste leachates using *Drosophila melanogaster* as an alternate animal model
13.	Dr. Ian D. Simpson	Snake bite and its management
14.	Madhu Singh	SNPs in CYP2D6 gene in Indian population
15.	Madhulika Tripathi	Nimesulide induced hepato-toxicity and its amelioration with a traditional herb *Solanum nigrum* Linn.
16.	Maqusood Ahamed	Organochlorines exposure and risk of childhood aplastic anemia

17.	Meenakshi Tewari	Exploration of antioxidant potential of *Zingiber officinale* Rosc. using t -butyl hydro-peroxide stressed rat macrophages
18.	MP Singh	Selected volatile organic compounds: A study to document adverse effects of exposure using *Drosophila* as a model
19.	Munindra Ruwali	Association of genetic polymorphism in ethanol and nicotine metabolizing cytochrome P450s and glutathione-S transferase genes with head & neck cancer
20.	Nahid Akhtar	Trans-placental disposition and teratogenic effect of Chlorpyrifos in rats
21.	Neetu Kalra	Mechanism of apoptosis induction by black tea in human prostate cancer cell line lymph node carcinoma prostate
22.	Neha Saxena	Surveillance of the commonly encountered mycotoxin Patulin
23.	Neha Sharma	Hydrochemistry of wet atmospheric precipitation over an urban area
24.	Priyanka Ojha	Vertical distribution of chemical contaminants in soil of Panki-an industrial area of Kanpur
25.	Pushpa Lata	Prevalence of gelE gene in environmental isolates of Enterococci
26.	Rakhi Agarwal	Role of Selenium in mercury intoxication
27.	Ranu Tripathi	Identification and quantification of PAHs in soil and sediment of Gomti River in Lucknow city
28.	RN Bhargava	Characterization of bio-transformed metabolite of phenolic coloring constituent in post methanated extracts
29.	Sahdeo Prasad	Prostate cancer: an overview
30.	Sangeeta Yadav	Role of wetland plant for bioremediation of distillery effluent after bacterial pretreatment
31.	Santosh Yadav	Use of biomarkers to assess the bio-reactivity of asbestos
32.	Sapna Sharma	Antioxidant, antimicrobial capacity and Rapid Amplified Polymorphic DNA profile of ginger collected from different ecological zones of India

33.	Shail Singh	Isolation and characterization of pentachlorophenol degrading bacteria from pulp paper mill waste
34.	Siya Ram	Virulence genes fingerprinting of *E. coli* isolates from river ganga
35.	Sunishtha Singh Yadava	Genetic polymorphism in cytochrome P450C19 and susceptibility to oral cancer
36.	Sushila Patel	Mechanism of cypermethrin induced DNA damage in Drosophila melanogaster
37.	Virendra Singh	A study on the association of cytochrome P450A1 polymorphism and breast cancer risk in north Indian population

Honours and Awards

- Dr. Virendra Misra, nominated as Member, Supreme Court Technical Expert Committee on 'Ship Breaking'

- Dr. Virendra Misra, nominated as Member, Research Advisory and Monitoring Committee (RAMC), Central Pollution Control Board, Delhi.

- Dr. Deepak Agrawal nominated Member, Technical Committee for drafting the NABL Specific Guidelines for Biological Testing Laboratories (NABL publication # 102), Issued for implementation on February 2, 2007.

- Dr. Deepak Agrawal nominated Member, Toxicology Expert Panel for evaluation of regulatory submissions to Central Insecticides Board and Registration Committee, Ministry of Agriculture, New Delhi 2007.

- Dr. Deepak Agrawal appointed Regional Coordinator, "WHO/TDR - GLP Network Asia", 2007 with US$ 49,900/- for supporting GLP training and implementation activities in India and other countries in Asia.

- Dr. Krishna Gopal appointed member of Research Degree Committee for Environmental Sciences in Bundelkhand University, Jhansi.

- Dr. Krishna Gopal nominated member for Research Advisory Committee, UP, Council of S & T, Lucknow

- Dr. Krishna Gopal won IIIrd Prize in National Conference Organized by "The Academy of Environmental Biology" ITRC, LUCKNOW held at "School of Environmental Biology" Avadhesh Pratap Singh University, Rewa (M.P.) from Dec 23-25, 2006.

- Dr S.K.Bhargava nominated Chairman, Environmental Quality of the Expert State Level Impact Assessment Authority, U.P. from July 2007.

- Dr. Krishna Gopal nominated Member, EIA Process of the Expert State Level Impact Assessment Authority, U.P. from July 2007.

- Dr Kr. P. Singh nominated Member, EIA Process, Environment Quality of the State Level Environment Impact Assessment Authority, U.P.; constituted by MoEF,Govt. of India from July, 2007.

- Dr. Poonam Kakkar appointed as one of the Director's of Governing body of Periyar Technology Incubator under the Periyar Mannamai University, Thanjavur in May 2006.

- Dr. Poonam Kakkar elected executive council member, Society for Free Radical Research-India, a constituent body of SFRR-International for the period 2007-2009.

- Dr. Mukul Das elected as Fellow of National Academy of Agricultural Sciences (FNAAS).

Dr. Mukul Das receiving the FNAAS award from Prof. M.S. Swaminathan, President of National Academy of Agricultural Sciences on June 4, 2007 at New Delhi.

Dr D. K. Chowdhuri receiving UK-India Excellence in Research Initiative(UKIERI) Major Award by British Council on January 18, 2007

- Dr Mukul Das nominated as Advisory Board Member for 'Toxicology International' journal.

- Dr. Mukul Das has been nominated as DBT Task Force Member on 'Biotechnological approaches for food and nutritional security, New Delhi, 2006 09.

- Dr. Mukul Das nominated as Chairman, Food Additives Section Sub-committee, FAD 8, Bureau of Indian Standards, New Delhi, March 12, 2007.

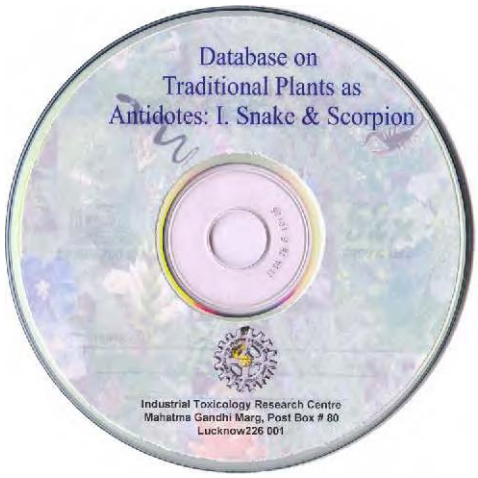
- Dr. V. P. Sharma has been elected as Secretary of Uttar Pradesh Association of Science & Technology Advancement for 2006-2008.

- Dr. D.Kar Chowdhuri**,** Scientist, was awarded the first UK-India Excellence in Research Initiative by British Council on January 18, 2007 (UKIERI) Major Award**.**

- Dr. Yogeshwer Shukla was elected as General Secretary of Environmental Mutagenesis Society of India for 2007-2009.

Intellectual Property Filed

A joint patent was filed by Industrial Toxicology Research Centre (ITRC), Lucknow, International Centre of Genetic Engineering & Biotechnology (ICGEB), New Delhi and Department of Biotechnology (DBT), New Delhi, Govt of India for "**PCR based method for detection and identification of Vegetative insecticidal protein (*vip3A* type) gene in GM plants and product thereof**". D.N. Kachru, Chandra K. Singh, Abhishek Ojha, R. K. Bhatnagar (Provisional Indian patent no. 1891/DEL2006; Reference no. 0135NF2006/IN)



A database of Traditional Plants as Antidotes: 1. Snake and Scorpion (Copyright No. : 081/CR/2006). F. N. Jaffery, Anvita Shaw, Madhumita Pattanayak, Seema Dogra, S. H. N. Naqvi.

MoU Signed and Technology Transferred

- Technology of improved version of ITRC Water analysis kit was transferred on October 4, 2006 to M/s Bharti Waters, Delhi.

- MoU between ITRC and UP Jal Nigam, Lucknow was signed on July 5, 2006 for providing technical consultancy to Jal Nigam, SWSM and DWSMs as State Referral Institute.

Dr. D.K. Saxena, Dy. Director (second from right) handing over the technology of improved version of ITRC Water analysis kit to Bhartiya Waters, New Delhi.

Ph.D. Awarded

Name of student	Supervisor	Title of thesis	University	Year of award
Shweta Agrahari	Dr. Krishna Gopal	Studies on monocrotophos induced biochemical and histopathological changes in *Channa punctatus*	Lucknow University	2006
Vijay Naithani	Dr. Poonam Kakkar	Identification, evaluation of antioxidant potential and quality assurance of some plants used as herbal tea ingredients	Lucknow University	2006
Hind Lal	Dr. S.K. Goel	Impact on bacterial clearance, pulmonary surfactant and other biomolecules following trichloroethylene exposure	Dr. RML Avadh University, Faizabad	2006
Manoj Kumar Pandey	Dr. Mukul Das	Biochemical basis of toxicity of polycyclic aromatic hydrocarbon residues arising through edible oils	Lucknow University	2006
Praveen Kumar	Dr. Ram Chandra	Bacterial decolourization of melanoidins of distillery effluent	Dr.RML Awadh University, Faizabad.	2006
Sandeep Kr. Misra	Dr. Ram Chandra	Biodegradation of pyridine and picoline from industrial waste	Dr.RML Awadh University, Faizabad.	2006

Visits Abroad

- Dr. R.K. Hans, Scientist, presented a research paper entitled "*Spirodela polyrrhiza*: A test model for phototoxicity assessment" in the Euro-Arab Conference 27-29 Nov, 2006 held at Kuwait.

- Prachi Bajpai, CSIR-SRF, visited Beijing, China, to attend International Conference on Structural Genomics (ICSG 2006) in Beijing, China from October 22 - 26, 2006.

- Dr. M.M.K. Reddy, Scientist, awarded "Better Opportunities for Young Scientist in the Chosen Areas of Science and Technology (BOYSCAST) Fellowship (2006-2007) to carry out advanced studies in drug delivery for one year at John Hopkins, Baltimore, USA.

- Dr. D.K. Agarwal, Scientist, attended the First Meeting of WHO/TDR Network of GLP Trainers and provided GLP training to 65 Brazilian scientists at Rio-de-Janeiro, Brazil, from June 4-9, 2006.

- Dr Mukul Das, Scientist, visited Dubrovnik, Croatia, on invitation to attend "EUROTOX 2006", 6th CTDC conference, September 19-24, 2006.

- Dr. Alok Dhawan**,** Scientist, visited University of Bradford and University of Surrey, UK**,** under the UKIERI travel award from January 15-25, 2007.

- Dr. A.P. Sahu, Scientist, visited Milan, Italy from June-11-16, 2006 attended 28th International Congress on Occupational Health.

Externally Funded Research Projects (2006-2007)

Title	Funding Agencies	Principal Investigator
NMITLI project on "Latent M. tuberculosis : New targets, drug delivery systems and bio-enhancers and therapeutics-DPI components"	CSIR, New Delhi	Dr. D.K. Saxena
Third Party testing of environmental parameters	NTPC, SSTPS, Shaktinagar	Dr. S.K. Bhargava
Technical consultancy and advice to Jal Nigam SWSM & TWSM in administering and implementing NRDWQM&SP	CPU, UP Jal Nigam, Lucknow	Dr. K. Gopal
Third party testing and monitoring of stack emission, ambient air monitoring and water effluent testing and annual environmental audit of ATPS, UPRVUNL, Anpara	Executive Engineer Operation General & Chemistry Division Anpara, Sonebhadra	Dr. S.K. Bhargava
Testing of environmental parameters of 2x210 MW Unit, Parichha Thermal Power Project	Parichcha Thermal Power Project, UPRVUNL, Parichha, Jhansi	Dr. S.K. Bhargava
Environmental monitoring for stack gas, ambient air quality, effluent water analysis and sludge analysis etc. at Hindalco Industries ltd., Renukoot	Hindalco Industries Ltd., Renukoot	Dr. S.C. Barman
Rapid EIA of 110 TPD Plant of KCIL	Kanoria Chemicals & Industries Ltd., Renukoot	Dr. S.C. Barman
Environmental monitoring at FGUTPP	NTPC, FGUTPP, Unchahar, Raibareilly	Er. A.H. Khan
Toxicity studies and molecular assays for transgenic plants	Nirmal Seeds Pvt. Ltd., Pachora, Jalgaon	Dr. D.N. Kachru
Third party testing and stack emission ambient air, water, effluents and preparation of annual audit report of PTPP	Parichha Thermal Power Project, Parichcha, Jhansi	Dr. S.K. Bhargava
Safety evaluation of GRP pipes for potability of water	Graphite India Ltd., Nashik	Dr. V.P. Sharma

Monitoring of mercury concentration in components of environment and its bioaccumulation.	MOEF, New Delhi	Dr. J. R. Behari
Golden Triangle partnership project	CSIR, New Delhi	Dr. P. Kakkar
Molecular approach of assessing the relationship between environmental exposure and male infertility under WOS-A scheme	DST, New Delhi	Dr. D.K. Saxena Dr. N. Pant-Woman Scientist (DST)
In-vitro models of cerebral stroke: tool for evaluation of neuro-protective potential of herbal drugs	ICMR, New Delhi	Dr. A.B. Pant
Carcinogen risk assesment of urban ambient air ultrafine particulate matter	DST, New Delhi	Dr. S. Kumar
Occupational dust toxicity and health risk assessment in bone based in organised industrial units of Uttar Pradesh : Recommendations for remedial measures	UPCST, Lucknow	Dr. I. Ahmad
To study the genetic stability of bacterial strain from earthworm gut for in-situ application in detoxification of endosulfan	UPCST, Lucknow	Dr. R.K. Hans
Monitoring of pesticide residue at national level : A network project on pesticide residue	Indian Agricultural Research Institute, New Delhi	Dr. R.B. Raizada
Flowcytometric analysis of DNA ploidy and cell cycle in buccal mucosal cell in smokeless tobacco consumers	ICMR, New Delhi	Dr. Y. Shukla
Phytoremediation of arsenic by aquatic macrophytes: role played by phytochelatin synthase in its detoxification	DST, New Delhi	Dr. R. Shanker Dr. P. Vajpayee-Woman Scientist (DST)
Studies on long term functional restoration following neural progenitor cell transplantation in rat model of cognitive dysfunction	ICMR, New Delhi	Dr. A.K. Agarwal Ms. N. Srivastava-SRF
Effect of RNA silencing in the management of prostate cancer : A mechanistic approach	ICMR, New Delhi	Dr. Y. Shukla Ms. S. Tyagi-JRF

Evaluation of allergenic potential of leguminous crops	ICMR, New Delhi	Dr. P.D. Dwivedi Ms. A. Mishra-SRF
Modulation of free radical mechanisms during hepatotoxicity and its amelioration by *Crataeva nurvala*	ICMR, New Delhi	Dr. P. Kakkar Ms. A. Kumari-SRF
Neurotoxicity of selected synthetic pyrethroid (Lambadacyhalothrin) and organophosphate (Monocrotophos and Dichlorvos) pesticides : behavioral, neurochemical, and immunohistochemical studies in developing and young rats	ICMR, New Delhi	Dr. V.K. Khanna
Testing of hazardous elements in sludge from dyeing effluents	Coir Board, Central Coir Res. Instt. Kalavoor, Alappuazha	Dr. V. Misra
GC-MS analysis of pheromones in animal urine/mucous samples	IVRI, Izatnagar	Dr. J. R. Behari
Toxicity studies of a natural formulation FF-2	Flex Foods Ltd., Noida	Dr. R.B. Raizada
Clean up measures and environmental improvement of illegal hazardous dump sites	UPPCB, Lucknow	Dr. V. Misra
Toxicological evaluation of water treatment tablets	CSMCRI, Bhavnagar	Dr. R.B. Raizada
Evaluation of Zn deficiency among children in different regions of India	AIIMS, New Delhi	Dr. D.K. Patel
Preparation of environmental audit reports on annual and monthly basis	Panki Thermal Power Station, Panki, Kanpur	Mr. M.M. Kidwai
Toxicological evaluation of *Bacillus sphaericus* strain	Defence Research Laboratory, Ministry of Defence, Tezpur	Dr. R.B. Raizada
Efficacy of toxicity testing of herbal products of NBRI	Director, NBRI, Lucknow	Dr. R.B. Raizada

Research Council (2006-2007)

Prof. M.S. Valiathan Honorary Adviser Manipal Academy of Higher Education Madhav Nagar, Manipal-576119	Chairman
Dr. H.N. Saiyed Director National Institute of Occupational Health Ahmedabad-380016	Member
Dr. T.P. Singh Head, Department of Biophysics and Dean All Indian Institute of Medical Scinces, Ansari Nagar, New Delhi-110 029	Member
Prof. S.K. Gupta Director General and Dean Institute of Clinical Research (India) A-201, Okhla Industrial Area, Phase I New Delhi-110 020	Member
Dr. Lalit Kant Sr. Dy. Director General Indian Council of Medical Research Ansari Nagar, New Delhi-110 029	Member
Dr. D.B.A. Narayana Head, Herbals Research, Hindustan Lever Research Centre, 64, Main Road, Whitefield, Bangalore-560 066	Member
Dr. V. Rajagopalan Chairman, Central Pollution Control Board Parivesh Bhawan, CBD cum Office Complex, East Arjun Nagar, New Delhi-110 032	Member
Dr. Indrani Chandrasekharan Director (E), Room No. 705, Ministry of Environment & Forests CGO Complex, Paryavaran Bhavan, Lodi Road, New Delhi-110 003	Member (Agency representative)

Dr. C.M. Gupta Director Industrial Toxicology Research Centre Lucknow	Member
Dr. O.P. Agarwal Head, RDPD Council of Scientific and Industrial Research New Delhi	DG's Nominee
Dr. D.K. Saxena Dy. Director Industrial Toxicology Research Centre Lucknow	Secretary

(L to R) Dr C.M. Gupta, Director, ITRC; Prof. M.S. Valiathan, Chairman RC and Dr D.K. Saxena, Secretary RC.A meeting of the Research Council in progress.

Management Council (2006-2007)

Dr. C.M. Gupta Director ITRC, Lucknow	Chairman
Dr. Rakesh Tuli Director NBRI, Lucknow	Member
Shri B.D. Bhattacharji Scientist E-II & Head, RPBD ITRC, Lucknow	Member
Dr. Ashwani Kumar Scientist 'F' ITRC, Lucknow	Member
Dr. (Mrs.) Poonam Kakkar Scientist E-II ITRC, Lucknow	Member
Dr. Rishi Shanker Scientist E-II ITRC, Lucknow	Member
Dr. M.P. Singh Scientist 'C' ITRC, Lucknow	Member
Shri B.K. Mishra F&AO ITRC, Lucknow	Member
Mr. Raj Kumar Upadhyay Assistant Engineer ITRC, Lucknow	Member
Shri Tariq Qutubuddin C.O.A. ITRC, Lucknow	Member Secretary

Publications

1. Abhai Kumar; Patel S; Gupta YK; Singh MP. Involvement of endogenous nitric oxide in myeloperoxidase mediated benzo(a)pyrene induced polymorphonuclear leukocytes injury. Mol Cell Biochem: 286; 2006; 43-51.

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Monographs on herbal drugs

Seven monographs on ayurvedic drugs of single plant origin developed by Dr. P. Kakkar have been published in **Ayurvedic Pharmacopoeia of India**, Vol. V, Part-I 2006. Details are:

Common name	Botanical name	Page No.
1. Gavedhuka (Root)	*Coix lachryma-jobi* Linn.	35-36
2. Karnasphota (Seed)	*Cardiospermum halicacabum* Linn.	67-68
3. Karnasphota (Root)	*Cardiospermum halicacabum* Linn.	69-70
4. Kattrna (Whole Plant)	*Cymbopogon citratus (DC.)* Stapf	71-73
5. Khubkalan (Seed)	*Sisymbrium irio* Linn.	82-83
6. Ksirakakoli (bulb)	*Fritillaria roylei* Hook	86-87
7. Parasikayavani (Seed)	*Hyoscyamus niger* Linn.	130-131

Publication	Number
Research Papers	127
Book Chapters	07
Monographs	07
Average Impact Factor	1.88

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Director In-Charge

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Dr. Devendra Parmar, Scientist Gr. IV(4)
Dr. V.P. Sharma, Scientist Gr. IV(4)
Dr. Alok Dhawan, Scientist Gr. IV(3)

Dr. V.K. Khanna, Scientist Gr. IV(3)
Dr. A.B. Pant, Scientist Gr. IV(2)
Dr. C.S. Ojha, Gr. III(7)
Mr. Kailash Chandra, Gr. III(5)
Mr. B.K. Maji, Gr. III(5)
Mr. B.S. Pandey, Gr. II(3)
Mr. Rajesh Mishra, Gr. II(1)
Mr. Mohd. Aslam, Sr. Stenographer

Dyes and Food Adulterant Toxicology
Dr. Mukul Das, Scientist Gr. IV(5) & Head
Dr. P.D. Dwivedi, Scientist Gr. IV(3)
Mr. R.C. Pandey, Gr. III (6)
Mrs. Sumita Dixit, Gr. III(5)
Mr. S.K. Purshottam, Gr. III(4)

Ecotoxicology
Dr. Virendra Misra, Scientist Gr. IV(5) & Head
Dr. B.S. Khangarot, Scientist Gr. IV(4)

Embryotoxicology
Dr. D.K. Saxena, Scientist Gr. IV(5) & Head
Dr. D. Kar Chowdhuri, Scientist Gr. IV(4)
Mr. Ram Narayan, Gr. III(4)
Mrs. Archana Agrawal, Jr. Stenographer

Environmental Biotechnology
Dr. Ashwani Kumar, Scientist Gr. IV(5) & Head
Mr. N. Manickam, Scientist Gr. IV(3)
Dr. M.P. Singh, Scientist Gr. IV(2)

Environmental Carcinogenesis
Dr. Sushil Kumar, Scientist Gr. IV(5) & Head
Dr. Yogeshwer Shukla, Scientist Gr. IV(4)
Dr. (Ms) K.P. Gupta, Scientist Gr. IV(4)
Mr. U.K. Singh, Gr. III (5)
Mr. S.H.N. Naqvi Jr., Gr. II(1)

Environmental Chemistry and Waste Water Analysis
Dr. Kr. P. Singh, Scientist Gr. IV(5) & Head

Dr. Dinesh Mohan, Scientist Gr. IV(2)
Mr. Ranjan Kumar, Scientist Gr. IV(1)
Mr. Satya Ram, Gr. II(3)

Environmental Microbiology
Dr. Rishi Shankar, Scientist Gr. IV(4) & Head
Dr. Ram Chandra, Scientist Gr. IV(4)
Mr. A.K. Verma, Gr. II (4)

Environmental Monitoring
Dr. S.K. Bhargava, Scientist Gr. IV(5) & Head
Mr. H.O. Misra, Scientist Gr. IV(4)
Mr. M.M. Kidwai, Scientist Gr. IV(4)
Dr. S.C. Barman, Scientist Gr. IV(3)
Dr. G.C. Kisku, Scientist Gr. IV(4)
Er. A.H. Khan, Scientist Gr. IV(3)
Mr. Chandra Prakash, Gr. II(4)
Mr. Tajuddin Ahmad, Gr. II(2)
Mr. Pradeep Kumar Shukla, Gr. II(1)

Epidemiology
Dr. S.K. Rastogi, Scientist Gr. IV(5) & Head
Dr. A.K. Srivastava, Scientist Gr. IV(5)
Mr. N. Mathur, Scientist Gr. IV (5)
Dr. A.K. Mathur, Scientist Gr. IV (4)
Dr. Mohan Das, Scientist Gr. IV(4)
Dr. Vipin Bihari, Scientist Gr. IV(3)
Dr. J.S. Gaur, Scientist Gr. IV(2)
Dr. C. Kesavachandran, Scientist Gr. IV(2)
Mr. B.S. Pangtey, Gr. III (6)
Mr. Abhimanyu Singh, Gr. III(6)
Mr. R.S. Bharti, Gr. II(4)

Fibre Toxicology
Dr. Iqbal Ahmad, Scientist Gr. IV(4) & Head
Mr. Mohd Ashquin, Gr. III(5)

Herbal Research
Dr. Poonam Kakkar, Scientist Gr. IV(4) & Head
Dr. A.K. Khanna, Scientist Gr. IV(3)

Mr. R.P. Singh, Gr. II(4)
Mr. J.C. Awasthi, Gr. II(1)

Immunobiology
Dr. A.K. Saxena, Scientist Gr. IV(5)
Dr. B.N. Paul, Scientist Gr. IV(4)
Dr. S.L. Nagle, Scientist Gr. IV(3)
Dr. S.C. Srivastava, Scientist Gr. IV(3)
Mrs. Balbir Kaur, Jr. Stenographer
Mr. Hari Ram, Gr. I(3)

Immunotoxicology
Dr. (Mrs.) Shashi Khandelwal, Scientist Gr. IV(4) & Head
Mr. R.S. Verma, Gr. II (3)

Inhalation Toxicology
Dr. A.K. Prasad, Scientist Gr. IV(3) & Head
Dr. V. Suresh Kumar, Scientist IV(1)
Dr. Kewal Lal, Gr. III(5)
Mr. U. Mani, Gr. III(2)
Mr. Dheer Kumar, Gr. II(3)
Mr. Ram Kumar, Gr. I(4)
Mr. Shiv Pyare, Gr. I(3)

Neurotoxicology
Dr. Mohd Ali, Scientist Gr. IV(5) & Head
Dr. Pramod Kumar, Gr. III(5)

Pesticides Toxicology
Dr. R.B. Raizada, Scientist Gr. IV(5) & Head
Dr. L.P. Srivastava, Scientist Gr. IV(4)
Dr. M.K. Srivastava, Gr. III(5)
Mr. R.P. Singh, Gr. III(5)
Mr. S.P. Dhruv, Gr. III(5)
Mr. K.P. Gupta, Gr III(4)
Mr. Ashok Kumar, Gr. II(4)
Mrs. Syamala Das, Gr. II(3)

Petroleum Toxicology
Dr. G.S.D. Gupta, Scientist Gr. IV(5) & Head

Dr. S.K. Goel, Scientist Gr. IV(4)
Mr. Ram Surat, Gr II(4)
Mr. Abdul Aziz, Gr. II (4)
Mrs. Mumtaz Jahan, Gr. II(3)

Photobiology
Dr. R.K. Hans, Scientist Gr. IV(4) & Head
Dr. Uma Shankar, Scientist Gr. IV(3)
Dr. Ratan Singh Ray, Scientist Gr. IV(3)
Dr. Mohd. Farooq, Scientist Gr. IV(3)
Dr. R.B. Misra, Gr. III (5)

Preventive Toxicology
Dr. A.P. Sahu, Scientist Gr. IV(4) & Head
Mr. R.K. Tewari, Gr. II(3)
Mr. Chedi Lal, Gr. I(4)

Safety Evaluation of GM-Drugs
Dr. D. K. Agarwal, Scientist IV(3) & Head

Toxicokinetics
Dr. Jai Raj Behari, Scientist Gr. IV(5) & Head
Mr. Ramesh Chandra, Gr. III(5)
Mr. Ram Chandra, Gr. II(4)
Mr. Anees Ahmad, Jr. Stenographer

S&T Sections
Analytical Chemistry
Dr. Jai Raj Behari, Scientist Gr. IV(5) & Head
Dr. M.M.K. Reddy, Scientist Gr. IV(2)
Dr. D.K. Patel, Scientist Gr. IV(2)
Dr. Rakesh Kumar, Gr. III(5)
Ms. Poonam Saxena, Gr. III(5)
Mr. Satgur Prasad, Gr. III(5)
Mr. B.K. Singh, Gr. II(4)

Animal Facility
Dr. D.C. Purohit, Scientist Gr. IV(4) & Head
Dr. Dhirendra Singh, Scientist Gr. IV(2)
Dr. B.P. Choudhari, Scientist Gr. IV(1)

Dr. Pradeep Kumar, Gr. III(4)
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Mr. P.K. Singh, Gr. III(1)
Mr. Dan Bahadur, Gr. II(4)
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Mr. M.L. Kanojia, Gr. II(4)
Mr. Hira Lal, Gr. I(4)
Mr. Mohan Lal, Gr. I(4)
Mr. Shiv Pyare, Gr. I(3)

Chemicals and Pollutants Analysis Unit
Dr. R.C. Murthy, Scientist Gr. IV(4), Head
Mr. G.S. Tandon, Gr. III(7)
Dr. R.K. Kanojia, Gr. III(3)

Computer Cell
Mr. Nikhil Garg, Scientist Gr. IV(3)
Mr. Umesh Prasad, Gr. II(3)

Distillation Unit
Dr. Jai Raj Behari, Scientist Gr. IV(5) & Head
Mr. Khalil Ahmed, Gr. II(3)

ENVIS Centre
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Dr. (Mrs) Anvita Shaw, Gr. III(5)
Mr. S.H.N. Naqvi, Gr. II(1)

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Dr. D.K. Saxena, Scientist Gr. IV(5) (Scientist-in-Charge)
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Mr. Saaduzzaman, Gr. III(7)
Mr. Arun Kumar, Gr. III(4)
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Mrs. M. Joshi, Gr. II(4)
Mr. Girish Chandra, Gr. II(4)
Mr. Surendra Kumar, Gr II(3)
Mr. B.C. Pant, Gr. II(3)
Mr. Mohan Lal, Gr. II(3)
Mr. Ram Bahadur, Gr. II(3) (Expired)

Mrs. Shanti Devi, Gr. I(4)
Mr. Kallu Prasad, Gr. I(3)

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Mr. Kishan Lal, Gr II(4)
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Mr. Naushad Ahmad, Gr. I(3)

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Dr. S.K. Bhargava, Alternate Quality Manager
Dr. V.P. Sharma, Technical Operation Manager
Dr. S. Khandelwal, Alternate Technical Operation Manager

Auditors - Biological
Dr. D.K. Saxena
Dr. Sushil Kumar
Dr. Shashi Khandelwal
Dr. S.K. Gupta

Auditors - Chemical
Dr. Virendra Misra
Dr. P.D. Dwivedi
Dr. Rakesh Kumar

Research Planning & Business Development Division
Mr. B.D. Bhattacharji, Scientist Gr. IV(4) & Head
Dr. K.C. Khulbe, Scientist Gr. IV(3)
Mr. V.G. Misra, Scientist Gr. IV(2)
Mr. V.K. Jain, Gr. III(6)
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Mrs. Shanti, Gr. I(3)

RTI Cell

Dr. D.K. Saxena, Appellate Authority
Mr. B.D. Bhattacharji, Public Information Officer
Dr. K.C. Khulbe, Asstt. Publication Information Officer

Service and Maintenance Unit

Mr. M.C. Tiwari, Scientist Gr. IV(4) & Head
Mr. J.P. Pratap, Gr.III(5)
Mr. Indrasen, Gr. II(3)

Infrastructure

Director's Office

Dr. (Mrs.) Chetna Singh, Scientist Gr. IV(2)
Mr. Subedar Ram, PS to Director
Mr. B.K. Jha, Sr. Stenographer
Mr. Narendra Singh, Gr. D (Non-technical)

Administration/Establishment Section

Mr. Tariq Qutubuddin, Sr. Controller of Administration
Mr. C.P. Arunan, Section Officer
Mr. Vivek Srivastava, Security Officer
Mr. R.A. Gupta, Security Officer
Mr. Yogendra Nath, Asstt Gr. I
Mr. Salauddin Khan, Asstt Gr. I
Mrs. Lila S. Pillai, Asstt Gr. I
Mr. D.C. Saxena, Asstt Gr. I
Mr. Ganga Prasad, Asstt Gr. I
Mrs. Kusum Lata, Sr. Stenographer
Mr. Prem Prakash, Sr. Stenographer
Mr. Kallu Ram, Sr. Stenographer
Mrs. C.K. Takru, Asstt Gr. I
Mr. S.S. Shukla, Asstt. Gr I
Mr. Samit Vij, Asstt. Gr. I
Mr. Ram Bilas, Sr. Stenographer
Mrs. Vijaya Suresh, Sr. Stenographer
Mr. C.M. Tewari, Sr. Hindi Translator
Mrs. Jai Laxmi, Asstt. Gr. II
Mr. Manoj Tiwari, Asstt. Gr. II
Mr. S.B. Singh, Asstt. Gr. III
Mr. Ajay Prasad Yadav, Asstt. Gr. III

Mr. Vijay Kumar, Gr. D. (Non-technical)
Mr. Yadu Nath, Gr. D. (Non-technical)
Mr. Mach Narayan, Gr. I(2)

Finance and Accounts Section

Mr. B.K. Misra, Finance and Accounts Officer
Mr. K.C. Paliwal, Section Officer
Mr. M.A. Khan, Asstt. Gr I
Mrs. A.T. Burrows, Asstt Gr. I
Mr. Suresh Kumar, Asstt, Gr. I
Mr. Lalit Kumar, Asstt. Gr. I
Mr. Ugrasen, Asstt. Gr. II
Mr. Raja Lal Dubey, Asstt. Gr. II
Mr. Kamta Prasad, Asstt., Gr. II
Mr. Tanuj Joshi, Jr. Stenographer
Mr. Mohd Ateeq, Gr. D (Non-technical)
Mr. Mahesh Yadav, Gr. D (Non-technical)

Stores & Purchase

Mr. L.R. Meena, Controller of Stores & Purchase
Mr. Vinay Kumar, S.P.O.
Mr. S.K. Singh, Dy. S.P.O.
Mr. Ram Badal, Dy. S.P.O.
Mr. Hardeep Singh, Asstt Gr. I
Mrs. Sheela Kureel, Asstt. Gr. I
Mr. S.N.A. Zaidi, Asstt. Gr. I
Mrs. Suman Yadav, Jr. Stenographer
Mr. Kushahar Prasad, Jr. Stenographer
Mr. Vikas Barua, Gr. D (Non-technical)
Mr. Raja Bux Singh, Gr. D (Non-technical)
Mr. Budhi Lal, Gr. D. (Non-technical)
Mrs. Chandra Kumari, Gr. D (Non-technical)

Engineering Unit (Civil)

Mr. Krishan Kant, Gr. III(3)
Mr. Raj Kumar Upadhyay, Gr. III(3)
Mr. A.K. Sinha, Gr. II(3)
Mr. P.S. Shukla, Gr. II(3)
Mr. Tribhuwan Dutt, Gr. II(2)
Mr. Ashok Kumar, Gr. II(3)

Mr. Amar Charan, Gr. II(3)
Mr. Shiv Kumar, Fieldman
Mr. Munsi Lal, Gr. I(4)
Mr. Hira Lal, Gr. I (4)
Mr. Mata Prasad, Gr. I(3)
Mr. Jagdish Prasad, Gr. I(4)
Mr. Putti Lal, Gr. D (Non-technical)
Mr. Anirudh, Gr. D (Non-technical)

Engineering Unit (Electrical & Mechanical)

Mr. Yogendra Singh, Gr. III(5)
Mr. S.S. Sundaram, Gr. III(1)
Mr. Nand Kishore, Gr. II(3)
Ms. Mona Hemrajani, Gr. II(3)
Mr. Prem Singh, Gr. II(2)
Mr. Devtadin, Gr. I(4)
Mr. Ajay Kumar, Gr. II(4)
Mr. Mazhar Abbas, Gr. I(4)

Canteen

Mr. Anoop Kumar, Manager
Mr. Ashok Kumar, Counter Clerk
Mr. Mohan Lal, Halwai
Mr. Mohd Quddus, Asstt. Halwai
Mr. Rajendra Kumar, Tea/Coffee Maker
Mr. Rajendra Yadav, Tea Maker
Mr. Umesh Chand, Bearer
Mr. Ram Yagya, Tea Maker
Mr. Sinod Kumar, Bearer
Mr. Rajesh Kumar, Wash Boy

Drivers

Mr. A.P. Pathak, Gr. II(4)
Mr. Mohd. Javed Gr. II(3)
Mr. Kalimuddin, Gr. II(3)
Mr. Balkishan, Gr. II(3)
Mr. A.K. Pathak, Gr. II(3)
Mr. Parvez Ahmad Khan, Gr. II(2)
Mr. Umesh Chandra Srivastava, Gr. II(1)

Promotions

Sl. No.	Name	Present Group	Group Grade after Promotion	Due date of Promotion
1.	Dr. A.K. Srivastava	IV(4)	IV(5)	11.07.2003
2.	Dr. (Smt.) Deepa Agrawal	IV(4)	IV(5)	01.02.2004
3.	Dr. Sushil Kumar	IV(4)	IV(5)	01.04.2004
4.	Dr. Virendra Mishra	IV(4)	IV(5)	04.05.2004
5.	Shri Neeraj Mathur	IV(4)	IV(5)	01.02.2005
6.	Dr. Ram Chandra	IV(3)	IV(4)	14.09.2004
7.	Dr. S.P. Pathak	IV(2)	IV(3)	01.01.2005
8.	Dr. Vinay Kumar Khanna	IV(2)	IV(3)	01.01.2005
9.	Dr. D.K. Patel	IV(1)	IV(2)	11.09.2004
10.	Dr. A.B. Pant	IV(1)	IV(2)	29.11.2004
11.	Dr. C.S. Ojha	III(6)	III(7)	01.02.2006
12.	Shri M.D. Rana	III(5)	III(6)	01.02.2006
13.	Shri B.K. Majhi	III(4)	III(5)	08.07.2005
14.	Shri K.P. Gupta	III(4)	III(5)	18.07.2005
15.	Shri S.P. Dhruv	III(4)	III(5)	24.07.2005
16.	Dr. U. Mani	III(2)	III(3)	21.01.2006
17.	Shri Pradeep Kumar Singh	III(1)	III(2)	11.09.2005
18.	Shri S. Sundaram	III(1)	III(2)	25.09.2005
19.	Shri P.S. Shukla	II(3)	II(4)	01.01.2004
20.	Shri Amar Charan	II(3)	II(4)	05.06.2005
21.	Smt. Mahewshwari Joshi	II(3)	II(4)	05.05.2005
22.	Shri Girish Chandra	II(3)	II(4)	16.03.2006
23.	Shri A.K. Verma	II(3)	II(4)	25.11.2005
24.	Shri Pyare Lal	II(2)	II(3)	01.06.2005
25.	Shri Naushad	I(2)	I(3)	05.02.2006

Superannuation

Name of Staff	Date of Superannuation
Sri Yogendra Nath	30.06.2006
Sri V.G. Mishra	30.06.2006
Dr. M. Mohd. Ali	30.06.2006
Dr. G.S.D. Gupta	30.06.2006
Sri Mazhar Abbas	31.07.2006
Dr. Anand Prakash Sahu	31.08.2006
Dr. Mohan Das	30.09.2006
Dr. S.K. Rastogi	30.09.2006
Sri Surendra Singh	30.11.2006
Sri Ashok Kumar	31.12.2006
Sri H.O. Mishra	31.12.2006
Sri A.K. Verma	31.01.2007

Staff Strength

Scientific Group IV	72
Technical Group III	43
Technical Group II	63
Technical Group I	19
Administration A	03
Administration B	32
Administration C	20
Administration D	17
Total	269

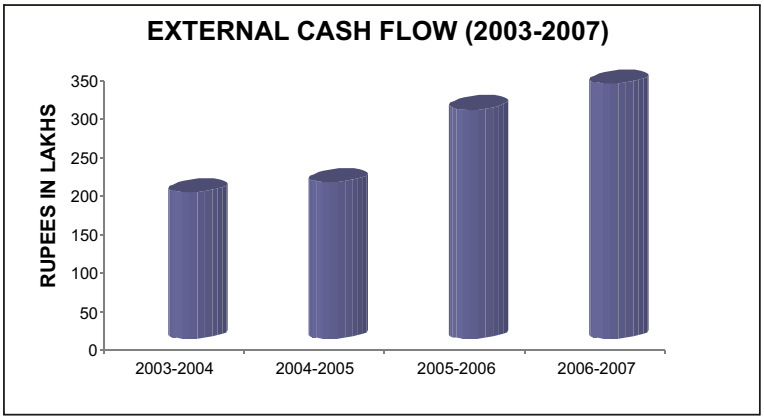
External Cash Flow (ECF)* generated during 2006-2007

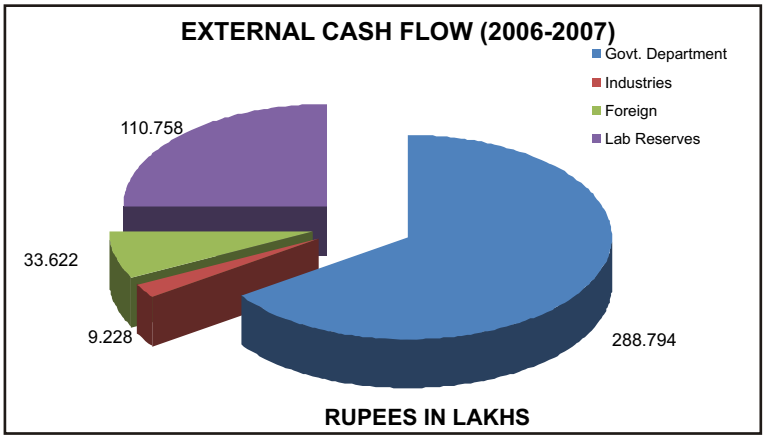
Govt. Department	-	288.794
Industries	-	9.228
Foreign	-	33.622
Lab Reserve	-	110.758
Total		442.378

Government budget* during 2006-2007

Plan	-	1043.531
Non Plan	-	787.813
Total		1831.244

*Rs in lakhs





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