ANNUAL REPORT

वार्षिक प्रतिवेदन

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भारतीय विषविज्ञान अनुसंधान संस्थान, लखनऊ

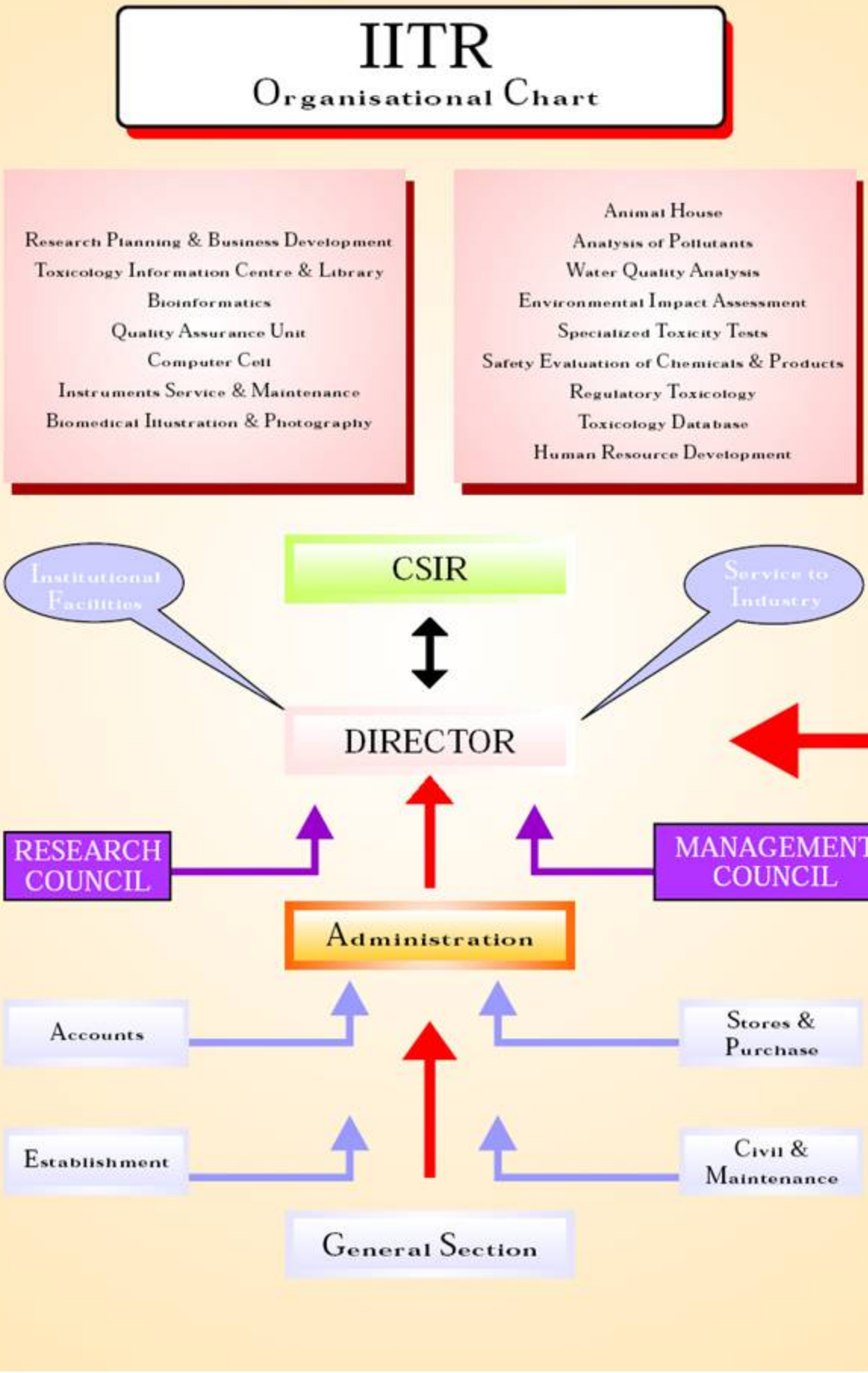
(पूर्ववर्तीः औद्योगिक विषविज्ञान अनुसंधान केन्द्र)

Indian Institute of Toxicology Research

(Formerly: Industrial Toxicology Research Centre)

Lucknow

IITR
Organisational Chart



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

Published by

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From the Desk of Director

I take great pleasure in presenting the Annual Report of 'Indian Institute of Toxicology Research, Lucknow, for the period of April 2007 March 2008, with a view to display our activities based on research work, societal programs and services to the industry.

This was an eventful year for the 'Institute' in many ways. First, its name was changed from 'Industrial Toxicology Research Centre' to 'Indian Institute of Toxicology Research'. Thus, our core activity remains as 'Toxicology Research', but we are now not limited to 'Industrial Toxicity' and are required to work on toxicity in all areas. This dramatically increases the scope of work and would require a substantial upgradation of both ideas and resources. I am confident that with the support of you all, we will be able to rise to the challenge and deliver the best. Incidentally, this year we also had to bear a significant loss when Prof. S.H. Zaidi, founder Director of our institute passed away on April 5, 2008. We would miss his affection and guidance and wish peace for the departed soul.

The Institute made significant progress in all the areas of research, and some of these are as under.

The indiscriminate use of pesticides and herbicides to increase crop productivity has aroused a great concern due to their adverse effects in both target as well as non-target species. Our data indicates that three tested pesticides have DNA damaging potential in mammalian cells in the order of dichlorvos > pedimethalian > cypermethrin. These should, therefore, be used with caution.

Quantitative structure toxicity relationship (QSTR) studies help in predicting the toxic potential of environment chemicals. The studies showed that benzene and its metabolites exhibit their genotoxic potential by docking with the key residues of ATP binding domain through hydrogen bonding, and inhibition of human topoisomerase II alpha.

In real life situation, we are normally exposed to complex chemical mixtures. Effects of leachates of solid waste from a flashlight battery factory and a pigment plant were, therefore, evaluated on 70kDa heat shock protein (Hsp70) expression, generation of reactive oxygen species (ROS), antioxidant enzymes activities and apoptosis in Drosophila. The study suggests that leachates of flashlight battery factory waste affected the organisms more adversely in comparison to the leachates of pigment plant waste.

L 929, a mouse fibroblast cell line, was used as an alternate test system for phototoxicity assessment, and the response of chloropromazine was found to be highest with sunlight, followed by UV A and UV B, respectively

Gene-environment interactions play an important role in development of lung cancer. In a study, the lung cancer risk was found to be increased by 2-4 fold in the patients carrying the genotype combinations of *CYP1A1*2A* and *GSTM1* or CYP1b1*2 and CYP1B1*3 with *GSTM1* suggesting the role of gene-gene interaction in lung cancer. Cigarette smoking, tobacco chewing or alcohol consumption were also found to interact with *CYP1A1* and *CYP1B1* genotypes in increasing the risk to lung cancer.

In our effort for long-term functional restoration of neural progenitor cell during transplantation, co-transplantation with olfactory ensheathing cells for neurotrophic factor support, or cografting with Zuckerkandl's organ was found to improve the long-term survival and function of neural stem cell derived dopaminergic neurons in 6-OHDA induced Parkinsonian rats.

Oral administration of low doses of lindane to pregnant dams from gestation day 5-21 produced dose-dependent alterations in the ontogenic profile of xenobiotic metabolizing cytochrome P450s (CYPs) in the brain and liver of offspring. The increase in the cerebral and hepatic mRNA expression was found to be associated with an increase in the catalytic activity of CYP isoenzymes in the brain and liver of the offspring at different stages during postnatal development. Interestingly the increase in mRNA expression of these CYP isoforms was found to persist upto adulthood, suggesting that the low doses of lindane administered to the dams might program the brain and liver of the offspring to permanently overexpress the xenobiotic metabolizing CYP isoforms.

In order to evaluate the sequence of events that might lead to the development of Parkinson's disease, gene expression patterns of the striatum of control and maneb + paraquat-induced Parkinson's disease (PD) phenotype in mouse was evaluated. Comparative transcription pattern showed a time of exposure dependent alteration in the expression of transcripts associated with several pathways i.e., oxidative stress, energy metabolism, cell cycle regulation, cell adhesion and apoptosis etc. RT-PCR reconfirmed the differential expression of some energy metabolizing transcripts. The results suggest that maneb + paraquat induce the neurotoxicity in striatum in a time of exposure dependent manner via multiple pathways and defective energy metabolism could play a critical role.

A study was undertaken to identify the differential display of proteins in cerebro spiral fluid by two-dimensional polyacrylamide gel electrophoresis and mass spectrometry. The results suggest that serum albumin precursor, serum albumin chain-A, PRR 14 and serum transferrin N-terminal lobe could be associated with neuronal dysfunction and hemoglobin/globin with the onset/progression of PD in humans.

The contamination of processed or unprocessed drinking water by fecal coliform bacteria has been reported worldwide. Despite a high incidence of waterborne diseases, Enterohemorrhagic Escherichia coli (EHEC) is an under acknowledged pathogen of concern

to public health in India. Coliform bacteria were enumerated in potable water samples collected from six locations in Lucknow by using the most probable number method. E. coli (n = 81), randomly isolated by membrane-filtration technique from four sites, were identified by biochemical characterization. E. coli were not detected in samples from two other sites. We screened 15 randomly selected isolates from each site for virulence determinants of EHEC using polymerase chain reaction (PCR). The isolates positive for virulence determinants (n = 18) were screened for sensitivity to 15 antimicrobials by the disk diffusion method. Both stx1 and stx2 genes were present in 33.3% of isolates, whereas others possessed either stx1 (11.1%) or stx2 (55.6%). eaeA, hlyA, and chuA genes were present in 100, 23.3, and 16.7% of isolates, respectively. Resistance to multiple antimicrobials was observed in potential EHEC.

Transgenic food, including maize (MNO810, Monsanto), is being cultivated globally and is increasing exponentially. The international safety regulations mandate the use of authentic and stable transgenics, and encourage detection methodologies for assessment of the transgenic material. Two distinct PCR assays were developed for this purpose. One in a standard array and the other in a multiplex format, facilitated concurrent detection of *cry1Ab* gene sequence (gene specific); maize genome – P-e35S adjoining sequence (event specific); hsp-cry1Ab sequence (construct specific), npt-II marker gene & two regulatory (P-e35S promoter & T-nos terminator) sequences- (GMO specific).

Consumption of mustard oil contaminated with argemone oil leads to a clinical condition called 'Epidemic Dropsy (ED)'. Enhanced relief was observed in Lucknow patients, when compared to patients from Patna. This may be due to the fact that antioxidant therapy including a-tocopherol was not given to Patna patients. Antioxidant therapy may, therefore, be beneficial to ED patients and needs detailed clinical trial in future.

Extracts of Ocimum sanctum were found to have a protective effect on 3-methylcholanthrene, 7,12- Dimethyl benz(a)anthracene or aflatoxin B1 induced skin tumorigenesis in mice.

Spices Board of India formulated a mandatory testing programme for the detection of Sudan dyes in all chilli consignments exported from India. For this reason, 800 non-branded loose chilli powder samples were checked for the magnitude of artificial colouration and presence of Sudan dyes. Sixty six percent samples were found to contain artificial Sudan dyes while only 33% were free from it. None of the branded chilli powder sample, however, had Sudan dyes.

Synthetic colours are added to food to replace natural colour lost during processing, to reduce batch-to-batch variation, and to produce products with consumer appeal. A study was carried out to find the type and level of synthetic food colours added to various eatables in the urban and rural areas of Lucknow. Inventory of coloured eatables showed that more types

and varieties of coloured eatables were prevalent in the urban areas than in the rural areas. Of the 1200 analyzed samples, 69% coloured eatables revealed the presence of permitted colours while 31% contained non-permitted colours. The use of non-permitted colours was found to be more in rural areas than in the urban areas. Also, the rural market samples contained permitted colours that were exceeding the maximum allowed prescribed levels, as compared to urban markets.

Positive Health Promoter (PHP) formulations have been developed under a network project for development of "Newer Scientific Herbal Preparations for Global Positioning" for (i) aged population; (ii) diabetes patients and (iii) breast 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 in vivo for anti-hyperglycemic and antioxidant activity. Individual extracts were subjected to fixed dose oral acute toxicity (OECD 420) and were found to be safe. Formulations comprising of these extracts prepared by the selected drug company is at present under evaluation for long term toxicity studies and in vivo antioxidant potential. Dossiers for these formulations have been prepared for regulatory agency and simultaneous clinical trials have been initiated.

In a separate study, acute oral toxicity studies were carried out for 20 traditional Ayurvedic formulations. The samples studied were Avipatticar curna, Amalkyadi curna, Eladi curna, Talisadi curna, Narsimha curna, Navayasa curna, Pusyanuga curna, Jiraksarishta, Draksharishta, Drakasasawa, Parthyarishta, Balarishta, Plihari Vati, Rajah Prawartani Vati, Shankh Vati, and Sanjivani Vati. All the tested formulations were classified as category 5 as per Globally Harmonized System (GHS) of OECD, suggesting them to be non-toxic in acute oral toxicity studies.

Golden Triangle Partnership project is a flagship project of CSIR to scientifically validate traditional medicine with an evidence-based approach and develop new formulations for 18 identified disease conditions. Medicinal plant samples (58) received under the project were tested for heavy metals and organochlorine pesticides before selection as raw material for formulations. The level of heavy metals and persistant pesticides in all the samples were found to be below the WHO permissible limits. Fixed dose acute oral toxicity studies were carried out for 8 herbal formulations i.e. GTP-0037, GTP-0050, GTP-0107, GTP-0111, GTP-0121, GTP-0122, GTP-0123 and GTP-0125. All the 8 formulations were found to be safe. Two formulations i.e. GTP-0037 for management of anxiety neurosis and GTP-0050 for management of Dyslipidemia, are now under clinical trials. Three Herbo-metallic formulations i.e. Mahayogaraj Guggulu, Arogyavardhini vati and Mahalaxmi vilas rasa were also found to be safe when subjected to oral acute toxicity and sub-acute oral toxicity studies (28 days). Mahalaxmi vilas rasa has now been subjected to 90-days oral toxicity studies as per OECD guidelines to check any adverse effect of this heavy

metal containing herbo-mineral formulation on long term usage.

In separate studies, Picroliv was found to protect cadmium induced testicular damage in rat. Anti-tumorigen effect of bromelain was found to be through mitogen activated protein kinase pathway in mouse skin. Chemopreventive Potential of Resveratrol in Mouse Skin Tumors was found to be through the regulation of Mitochondrial and PI3K/AKT Signaling Pathways. Lupeol and mango extract were found to induce apoptosis in mouse prostate and lymph node carcinoma of the prostate (LNCaP) cells.The results demonstrate that resveratrol modulates pyrogallol-induced changes in hepatic toxicity markers, xenobiotic metabolizing enzymes and oxidative stress.

In our efforts towards amelioration of pollutants in the environment, three aerobic bacterial strains, identified as Bacillus cereus (ITRC S6, DQ 002384), Serratia marcescens (ITRC S7, AY927692) and Serratia marcescens (ITRC S9, DQ 002385) were found to degrade pentachlorophenol (300 mg L^{-1}) upto 93.08% from pulp paper mill waste.

Source apportionment of pollutants is important in formulation of policies and initiating the remedial action. Polycyclic aromatic hydrocarbons (PAHs) in particulate depositions on vegetation foliages near highway in the urban environment of Lucknow city (India) were evaluated by using the principal components analysis/absolute principal components scores (PCA/APCS) receptor modeling approach. It identified three major sources of PAHs viz. combustion, vehicular emissions, and diesel based activities. The PCA/APCS receptor modeling approach revealed that the combustion sources (natural gas, wood, coal/coke, biomass) contributed 19–97% of various PAHs, vehicular emissions 0–70%, diesel based sources 0–81% and other miscellaneous sources 0–20% of different PAHs. The contributions of major pyrolytic and petrogenic sources to the total PAHs were 56 and 42%, respectively. Further, the combustion related sources contribute major fraction of the carcinogenic PAHs in the study area. High correlation coefficient (R^2>0.75 for most PAHs) between the measured and predicted concentrations of PAHs suggests for the applicability of the PCA/APCS receptor modeling approach for estimation of source contribution to the PAHs in particulates.

IITR is participating in All India Network projects on Monitoring of Pesticide Residues in food commodities at national level. 225 samples of vegetables (okra, brinjal, tomato, cauliflower and cabbage), 45 samples of fruits (apples, grapes, organge, pomegranates and papaya), 36 samples of wheat and rice, 9 samples each of milk and butter and 3 samples of ground water were analyzed for the presence of 14 organochlorines (Aldrin, α-HCH, β-HCH, γ-HCH, δ-HCH, butachlor, Chlordane, pp'-DDE, pp'DDD, ppDDT, dicofol, endosulfan I, Endosaulfan II, heptachlor), 7 pyrethroids (α-cypermethrin, β-cypermethrin, deltamethrin, fenvalerate, lamdacyhalothrin, fenpropathrin, β-cyfluthrin)

and 13 organophosphate (acephate, phorate, monocrotophos, phosphamidon, dimethoate, malathion, chloropyrifos methyl, chloropyrifos, fention, quinalphos, profenofos, chlorofevinfos and ethion) pesticide residues. It was observed that while most of the samples had pesticide residues, but their levels were well below their 'mean residue level' values. Some samples i.e. 25 vegetables, 6 fruits, 1 milk and 2 cereal samples showed presence of few organochlorine pesticide residues above their MRL values, but none of the butter and water samples were found contaminated with pesticide residues.

Institute has a state of art animal facility for animal breeding and experimentation. This facility was recently upgraded by equipping it by "individually ventilated cage system" to improve safety for animals and humans in research environment. Here, animals are maintained under positive pressure to avoid any contamination and each unit cage of the system act as an isolator. Inbred animals and susceptible hairless mouse or nude mouse can, therefore, be reared through IVC system. This IVC unit is ideal for various regulatory studies where observation of each individual animal is required. Other studies like evaluation of biopesticides (Microbials) may also be carried out with help of this instrument.

Zetasizer nanoZS-from Malvem Instruments, UK was installed at the institute this year for the measurement of size and zeta potential of nanoparticles, which will be evaluated for their safety and toxicity. The instrument measures dynamic light scattering in the range of 0.6 nm to 0.6 µm, and the zeta potential is measured using a laser in the range of 5 nm to 10 µm.

An International Conference on Nanomaterial Toxicology was jointly organized by Indian Institute of Toxicology Research, Lucknow and Indian Nanoscience Society on February 5-7, 2008. More than 110 participants from 11 countries namely U.S.A., Canada, U.K., Italy, Germany, France, Switzerland, Belgium, Brazil, Finland and India attended the conference. Researchers delivered 54 invited lectures in six scientific sessions and 29 posters were presented during the conference.

During this period, 109 research papers were published in peer reviewed journals along with 03 book chapters. The average Impact Factor per paper was 2.011. Fourteen research fellows were awarded Ph.D. degrees during this period.

Besides, IITR 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. IITR also continued 'market basket survey' in various parts of the country, to monitor adulteration/contamination in food stuffs.

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

I acknowledge the contributions made by our staff towards the success achieved by the 'Institute' during the year and look 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. P.S. Chauhan, Chairman, and other members of our Research Council for providing their able guidance for the development of our institute.

I assure you that IITR 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)

ITRC renamed as IITR

Renaming ceremony: unveiling the plaque with the new name IITR

February 1st 2008 was a momentous occasion for everyone at the erstwhile 'Industrial Toxicology Research Centre' when on the occasion of Renaming ceremony, the Acting Director of the Centre, Dr Ashwani Kumar in his welcome address announced the change in name of the Centre to 'Indian Institute of Toxicology Research'. He mentioned that ITRC has been in the service of nation with the motto "Safety to Environment & Health and Service to Industry" for the last 42 years. Gradually its range of activities increased beyond the industrial chemicals. The need for change in name was recommended by the Performance Appraisal Board of CSIR, which was subsequently approved by the Governing Body of CSIR. By giving the Centre a new name, while the core activity of the 'Institute' will be 'Toxicology Research' the scope of activities has now broadened and will include safety evaluation of GM foods, GM drugs, herbal products, nanomaterials and biotoxins, along with existing activities.

Dr Ashwani Kumar welcoming the guests on the occasion of Renaming ceremony

Dr P.S. Chauhan, Former Head, Department of Genetics, BARC, Mumbai and presently Chairman of the 'Research Council' of the Institute, was the chief guest on the occasion. In his address, Dr Chauhan said that toxicology is no more the Science of poisons. The domain of toxicology defines the levels of safety of a chemical. For over 40 years, ITRC has addressed various issues on toxicology and the name change now reflects the paradigm shift in the scope of toxicology. The new name plaque was unveiled by Dr P.S. Chauhan. Eminent scientists from local CSIR laboratories, Ex-Directors' of IITR and officials of various scientific institutions were present on the occasion.

Founder director Prof. S.H. Zaidi, leaves for his heavenly abode

Professor Sibte Hasan Zaidi (1918-2008)

Professor Sibte Hasan Zaidi, the Founder Director of the Indian Institute of Toxicology Research (IITR), Lucknow, passed away on April 5th, 2008 after a prolonged illness. He was an outstanding environmental and industrial toxicologist of the country. It was because of his untiring efforts that the Council of Scientific & Industrial Research, India, established ITRC (now IITR) in 1965. Prof. Zaidi was awarded MBBS degree in 1945 from King George's Medical College, Lucknow. He obtained the Postgraduate Diploma in Clinical Pathology and a Ph.D in Experimental Pathology in 1955 from Royal Postgraduate Medical School, University of London. From 1955 to 1964, he served as Head, Division of Experimental Medicine, Central Drug Research Institute, Lucknow. In 1964, he joined the Institute of Biochemistry and Experimental Medicine, Calcutta as Director. Subsequently, he moved to Lucknow and established Industrial Toxicology Research Centre, and became its first Director on November 4, 1965.

Prof. Zaidi's researches contributed significantly to various fields of experimental pathology, with particular reference to occupational lung diseases due to pathogenesis of particulate and fibrous dusts. He demonstrated the roles of tuberculosis infections in the causation of pulmonary massive fibrosis in coal miners and fungal infections in aggravating the fibrotic response in lungs that are exposed to many inorganic and organic dusts. He also demonstrated that in silicosis, nutritional factors do not alter pulmonary fibrosis. Prof. Zaidi has to his credit over one hundred original research papers published in journals of international repute. He is the author of the book entitled "Experimental Pneumoconiosis" published by John Hopkins Press, Baltimore, Maryland and has edited a book on "Environmental Pollution and Human Health".

He received numerous awards and honors, including the Fellowship of the Royal College of Pathologists, London, the Pathological Society of Great Britain and Ireland, the Indian National Science Academy, the National Academy of Sciences (India) and the Indian Academy of Medical Sciences. He has also been a member of WHO's Expert Advisory Panel of Occupational Health. Prof Zaidi was the recipient of Shanti Swaroop Bhatnagar Award, Sir Ardeshir Dalal Memorial Award, Dr William P. Pant Award and Padmashri. A 'S.H. Zaidi Oration' is organised every year at IITR in his honor. Prof Zaidi will always be remembered for his notable contributions and remain an inspiration for future generations.

R & D Highlights

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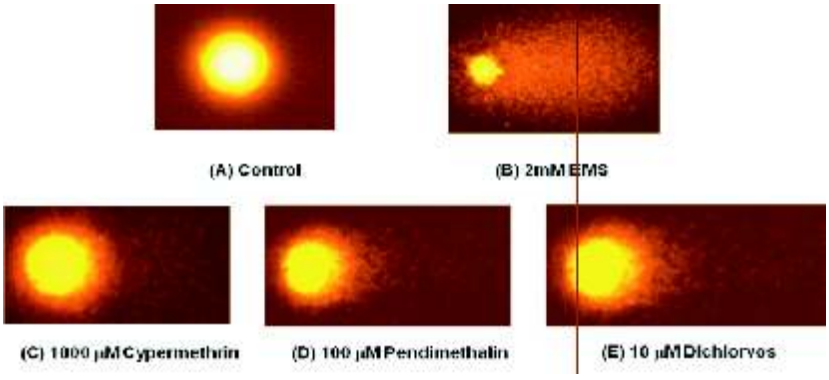
With
Compliments

(Ashwani Kumar)
Acting Director
IITR

1. Animal Models and Animal Substitute Technology for Risk Assessment

1.1 DNA damaging potential of pesticides

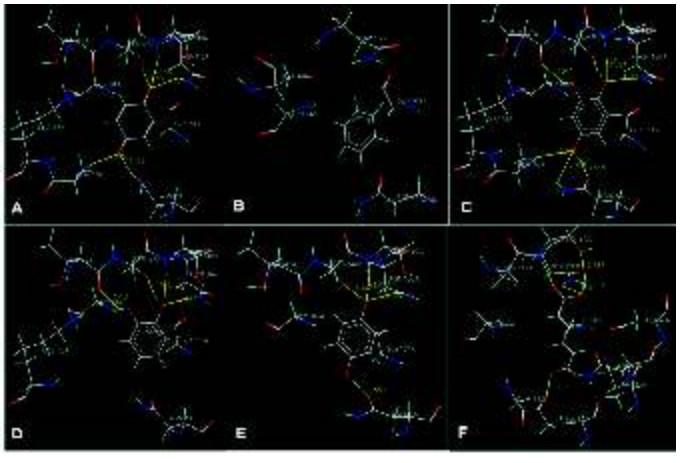
The indiscriminate use of pesticides and herbicides to increase crop productivity has aroused a great concern among the environmental and health scientists due to their adverse effects in both target as well as non-target species. Although substantial information is available regarding their environmental and ecological impact, not much is known in regard to its toxicity in the mammalian system. Therefore a study was conducted for the assessment of cytotoxic and genotoxic effects of cypermethrin (Type II pyrethroid) dichlorvos (organophosphate) and pendimethalin (dinitroaniline herbicide) in Chinese hamster ovary (CHO) cells. CHO cells were exposed to 1 µM, 10 µM, 100 µM, 1000 µM, and 10,000 µM, cypermethrin, pendimethalin and dichlorvos for 3 h and cytotoxicity was assessed by dimethyl thiazolyl diphenyl tetrazolium salt (MTT) assay. Their genotoxic potential was also evaluated by Comet assay. The results demonstrate that dichlorvos and pendimethalin exhibited higher extent of cytotoxicity as compared to cypermethrin. A significant ($p < 0.05$) concentration dependent increase in DNA damage was observed with dichlorvos (0.01 µM and above) and pendimethalin (0.1 µM and above) as evident by Comet assay parameters viz., Olive tail moment (arbitrary units), tail DNA (%) and tail length (lM). Cypermethrin induced a significant ($p<0.05$) DNA damage only at higher concentrations of 1000 and 5000 µM. Our data indicates that the DNA damaging potential of these chemicals in mammalian cells is in the order dichlorvos > pedimethalin > cypermethrin and hence they should be used with caution [S. Patel, M. Bajpayee, A. K. Pandey, D. Parmar, A. Dhawan (2007) Toxicol In Vitro 21:1409-1418].



CHO cells treated with different pesticides showing DNA damage (Magnification-400X): (A) nucleus from an untreated CHO cell (negative control), (B) nucleus from an ethyl methane sulfonate (2mM, positive control) treated CHO cell showing DNA damage, (C, D, E) nuclei from cypermethrin, pendimethalin and dichlorvos treated CHO cells showing DNA damage.

1.2 Genotoxicity of Benzene and its Metabolites: QSTR Studies and Interactions with Human Topoisomerase II Alpha

Quantitative structure toxicity relationship (QSTR) studies help in predicting the toxic potential of environment chemicals and have gained importance globally. In the present study, QSTR models were developed for identifying the genotoxic potential of benzene and its metabolites (hydroquinone, benzoquinone, benzenetriol, catechol, and muconic acid), and their interactions with human topoisomerase II alpha. QSTR models were built on *in vitro* data of DNA damage assessed by alkaline Comet assay, cytokinesis block micronucleus (CBMN) assay, flow cytometric analysis of micronucleus (flow MN) and chromosomal aberration (CA) test. The QSTR results demonstrated direct relationship ($r^2 \leq 0.95$ with $P < 0.01$) between the observed genotoxicity and that predicted by molecular descriptors such as distance between most hydrophilic and hydrophobic region, molar refractivity, oxygen atoms separated by five topological bond distances, number of hydrogen bond donor atoms taken in the models. Molecular docking studies with benzene and its metabolites were performed at the ATP binding domain (active site) of human topoisomerase II alpha, a key enzyme involved in DNA repair, replication, and chromosome segregation. The studies showed that benzene and its metabolites dock with the key residues of ATP binding domain through hydrogen bonding. This could help explain the mechanism of inhibition of human topoisomerase II alpha by benzene and its metabolites leading to genotoxicity.



Docking of compounds in the active site of human topoisomerase IIa enzyme A) Benzene, B) Benzoquinone, C) Benzenetriol, D) Catechol, E) Hydroquinone, F) Muconic Acid

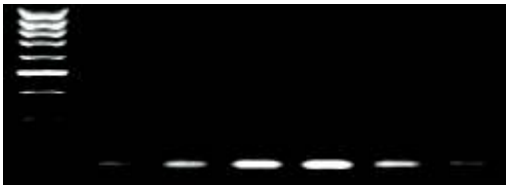
1.3 Induction of biochemical stress markers and apoptosis in transgenic *Drosophila melanogaster* against complex chemical mixtures: Role of reactive oxygen species

Complex chemical mixtures in the recent years have assumed importance due to real life exposure to organisms. The study was aimed to investigate the effect of leachates of solid waste from a flashlight battery factory and a pigment plant on 70 kDa heat shock protein (Hsp70) expression, generation of reactive oxygen species (ROS), antioxidant enzymes activities and apoptosis in Drosophila. Third instar larvae of *Drosophila melanogaster*

transgenic for hsp70 (hsp70-lacZ) were fed on diet mixed with leachates of solid wastes (0.05–2.0%, v/v) released from two industrial plants at three different pHs (7.00, 4.93 and 2.88) for 2–48 h. A concentration- and time-dependent significant change in Hsp70 expression, ROS generation, antioxidant enzymes activities and MDA content was observed in the exposed larvae preceding the antioxidant enzymes activities. Mitochondria-mediated, caspase-dependent apoptotic cell death in the larvae exposed to 1.0 and 2.0% leachates of flashlight battery factory was concurrent with a significant regression in Hsp70 expression and a higher ROS generation. A positive correlation drawn between ROS generation and apoptotic markers and a negative correlation between apoptotic markers and Hsp70 expression in these groups indicated the important role of ROS in the leachate-induced cellular damage. Hsp70 along with antioxidant enzymes offered protection to the organisms exposed to all the tested concentrations of the leachates of pigment plant waste and 0.5% leachate of flashlight battery factory in a cooperative manner when ROS generation was less induced. Conversely, higher levels of ROS generation in the organisms treated with 1.0 and 2.0% leachate of flashlight battery factory after 24 and 48 h resulted in regression of Hsp70 expression in them leading to cell death. The study suggests that (1) leachates of flashlight battery factory waste more adversely affected the organisms in comparison to the leachates of pigment plant waste. (2) Hsp70 may be used as a biomarker of cellular damage in organisms exposed to leachates. (3) Cell based assays using *D. melanogaster* as an *in vivo* model may provide important mechanistic information about the adverse effect of xenobiotics [H. R. Siddique, S. C. Gupta, K. Mitra, R. C. Murthy, D. K. Saxena, D. K. Chowdhuri (2007) Chemico-Biological Interactions 169: 171-188].

1.4 Status of Stat3 in an Ovalbumin-Induced Mouse Model of Asthma: Analysis of the Role of Socs3 and IL-6

Signal transducers and activators of transcription (Stat3), suppressor of cytokine signalling (Socs3) and cytokines play an integral role in the coordination and persistence of inflammation. However, a clear understanding of the role played by the Stat3/IL-6 and Socs3 pathway in airway inflammation is lacking. We report the alteration in the status of expression and activation of Stat3 by ovalbumin (OVA), and establish its relationship with Socs3 and IL-6 in the lungs of mice with eosinophilic pulmonary inflammation and airway hyperresponsiveness. Alterations in the expression of Stat3, Socs3 and IL-6 were determined in a murine model of asthma, where Balb/c mice were sensitized and challenged with OVA (OVA/OVA) and compared with control mice sensitized and challenged with saline (SAL) (SAL/SAL) mice. The OVA/OVA mice were characterized by a moderate increase in methacholine-induced specific airway resistance, the presence of 150µg/ml of OVA-specific IgG and 8.93 µg/ml OVA-specific IgE antibody and elevated levels of eosinophils and Th2 cytokines (IL-4 and IL-5) in the bronchoalveolar lavage fluid. In



Real time-PCR products of Stat3 mRNA expression profile in asthmatic mice treated with exogenous rIL-6 through the nasal route and compared with the Socs3 blocked asthmatic mice

contrast SAL/SAL mice had low eosinophils, IL- 4 and IL-5 and no OVA-specific IgG and IgE antibodies in the BALF. *Stat3* and *Socs3* expression profiles were monitored in OVA/OVA and *Stat3*- and *Socs3*-silenced OVA/OVA mice. Furthermore, expression of IL-6 in *Stat3*- and *Socs3*-silenced mice and the exogenous effect of IL-6 on *Stat3* were studied. The results show that expression and activation of *Stat3* mRNA and proteins are significantly low in lung of OVA/OVA mice in comparison to SAL/SAL mice following OVA challenge. An increased pool of Socs3 mRNA is observed in OVA/OVA mice with or without OVA challenge and in SAL/SAL mice 24 h after OVA challenge. Transient *in vivo* blocking of *Socs3* gene by *Socs3* siRNA restores the expression of IL-6 mRNA and protein in OVA/OVA mice, and nasal administration of recombinant IL-6 to OVA/OVA mice enhanced *Stat3* mRNA expression. Our data suggest that airway inflammation is associated with low expression of Stat3 and IL-6 and overexpression of *Socs3* genes in a mouse model of asthma. Furthermore, IL-6 is under the influence of the *Socs3* gene and may contribute to the negative regulation of Stat3 via IL-6 following a challenge with an allergen during the development of asthma [B.N. Paul, V. Mishra, B. Chaudhury, A. Awasthi, A. B. Das, U. Saxena, A. Saxena, L. K. Chauhan, P. Kumar, S. Raisuddin (2008) I Arch Allergy and Immunol; in press].

1.5 Safety studies of inhalable anti-tubercular drug micro particles

Safety studies of inhalable anti-tuberculosis drug in the form of micro particles (MP) containing isoniazid (INH), rifabutin (RFB), poly lactic acid, (PLA) were carried out in mice model using an in house made inhalation apparatus. Acute (single dose) and 90 days sub chronic inhalation studies were carried out and parameters like weekly body weight, organ weight, serum clinical enzymes, serum electrolytes, hematology and histopathology were recorded. A 90 days inhalation study was also carried out in monkey model using 1, 10 and 100 mg/animal of MP. Histopathology of all the tissues, blood, and serum and urine parameters along with allergenicity were performed. The studies showed no significant toxic effects of the drug in mice and monkey models.

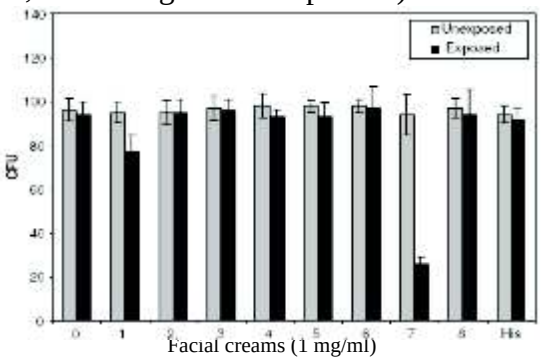
1.6 Use of L-929 cell line for the phototoxicity assessment of chemicals

L-929 is a mouse fibroblast cell line used as an alternate test system for toxicity assessment. Its photosensitivity towards ultraviolet radiation (UVR) and phototoxicity assessment of chlorpromazine (used as a major tranquilizer drug) was studied. MTT assay

was used for cell viability. Cells exposed to UV A (1.5 mW/cm^2)for 180 minutes, UVB (0.6 mW/cm^2) for 150 minutes, and sunlight 60 minutes, did not show alteration in cell viability significantly. Higher intensities and exposure for longer period showed a significant reduction in cell viability. Phototoxicity assessment of Chloropromazine (1-10 ppm) under UV A (2.7J/cm^2), UVB (1.44J/cm^2) and sunlight (30 minutes) exposure showed a dose dependent decrease in cell viability. Chloropromazine did not show significant toxic response in dark (unexposed) condition. The cell viabilities at 10 ppm chloropromazine concentration were 19.3, 34.5 and 56.9 percent under sunlight, UVA and UV B exposure, respectively. The phototoxic response of chloropromazine towards L929 cell line was in the following order: sunlight> UV A> UVB [R.S. Ray, N. Agrawal, A. Sharma, R.K. Hans (2008) Toxicol In vitro 22: 1775-1781].

1.7 Phototoxicity assessment of drugs and cosmetic products by using *E. coli*

A gram negative bacterium *Escherichia coli* (DH5 α strain) was used as an alternate test system of phototoxicity. Eight drugs and cosmetic products (face creams) were examined for their phototoxicity using this test system. Five known phototoxic compounds (Riboflavin, 8-MOP, Anthracene, Methylene blue, Rose bengal and Ampicillin) were used as controls. Decrease in colony forming units (CFU) was taken as an end point of phototoxicity. The phototoxic compounds and antibiotics produced significant reduction in CFU ($p < 0.001$) at 80 µg/ml concentrations under exposure to UVA-radiation (5.4–10.8 J/cm2). Only one face cream was found to be phototoxic and produced significant decrease in CFU of *E.coli* at 1.0 mg/ml concentration under UVA exposure at 10.8 J/cm2 (fig.). The observations suggested that *E. coli* can be used as an alternative test system for phototoxicity evaluation of chemicals. Thus, *E.coli* can be used as an alternate test system for phototoxicity studies in safety evaluation of various chemical ingredients or formulations used in cosmetics and drugs [K. Verma, N. Agarwal, R.B. Misra, M. Farooq, R.K. Hans (2008) Toxicol in vitro. 22: 249-253].



Changes in *E.coli* CFU by UVA (10.8 J/cm^2) exposed face creams (0 : control; 1-8: different brands of facial creams; His -L histidine

1.8 *Cypris subglobosa* for rapid monitoring of environmental pollutants

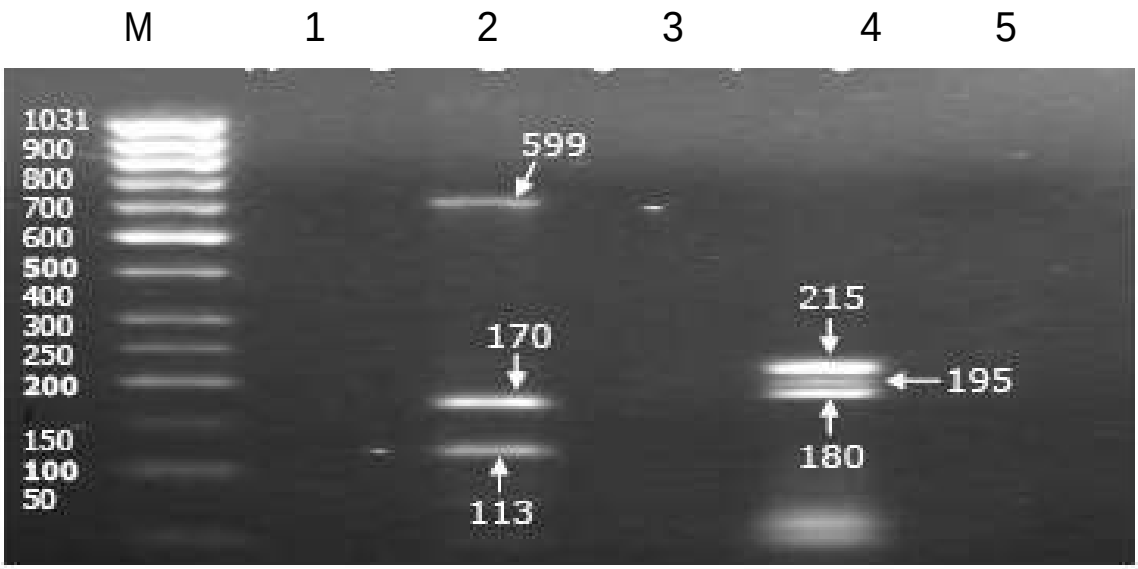
The acute toxicity of 36 metals and metalloids to a freshwater ostracod, *Cypris subglobosa* was evaluated on the basis of a 48h of 50 % decrease in immobilization (EC_{50}).

Acute toxicity tests for various metallic ions at 24h and 48h of exposure show sensitivity within the range reported for freshwater cladocerans, zooplanktons, invertebrates or fish. These results and the wide distribution of this species in the Southeast Asia make the ostracod bioassay a good possible alternative option for rapid monitoring of environmental pollutants in freshwater system in the region. The ostracod *C. subglobosa* bioassays have several practical advantages. For example, they are easy to handle, their maintenance in the laboratory is inexpensive, and they require shorter test periods, show discrete growth, need small volume of test water and lesser quantity of toxicant. The optimum small size allows large number of test species to be used for statistical design and analysis. These advantages make the present test model an extremely desirable species for aquatic toxicology studies in near future.

2. Detection and Safety Evaluation of GM Foods

2.1 Assessment of *cry1Ab* transgene cassette in commercial Bt corn MON810: Gene Event, Construct & GMO specific concurrent characterization

The cultivation of transgenic maize (MON810, Monsanto) is widespread globally & exponentially on increase. The international safety regulations mandate use of authentic and stable transgenics and encourage detection methodologies for assessment of the transgenic material, its labeling and rapid identification of spurious GM seed/produce. This study was aimed to develop simpler detection assays with universal assay conditions to characterize the entire transgene cassette in Bt corn (MON810) and verify the insert integrity. Two distinct PCR assays were developed, employing variable, multiple combinations of primer sets & assay conditions. The PCR assays; one in a standard array & the other in a multiplex format, facilitated concurrent detection of *cry1Ab* gene sequence (gene specific); maize genome–P-e35S adjoining sequence (event specific); hsp-*cry1Ab* sequence (construct specific), npt-II marker gene & 02 regulatory (P-e35S promoter & T-nos terminator) sequences (GMO specific). The standard simplex assay also enabled amplification of maize specific *hmgA* gene (internal control) and plant specific chloroplast t-RNA gene (positive control). The limit of detection for *cry1Ab* gene was determined simultaneously, by multiplex PCR assay (gene, event and construct specific) and it was 0.1%



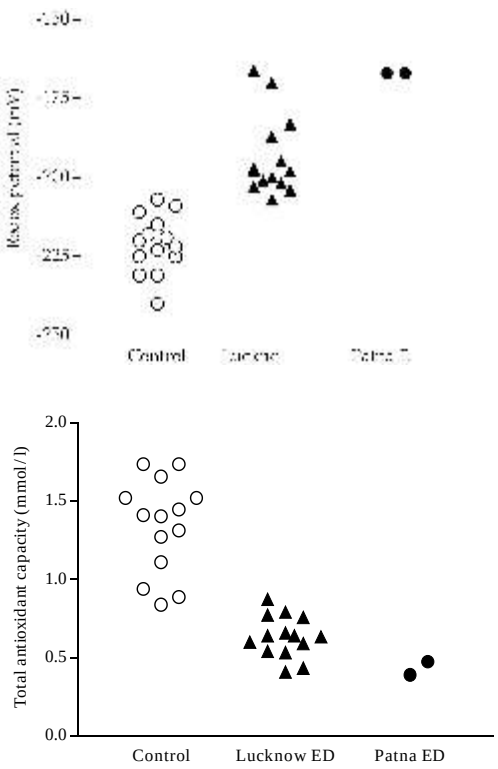
Multiplex PCR assays for commercial Bt corn- MON810.
Lane M: 50bp marker, Lane 1: Env. Control, Lane 2: Multiplex PCR assay for *cry1Ab* transgene with gene (*cry1Ab*, 599bp), event (maize genome - P-e35S,170bp) and construct (hsp-*cry1Ab*,113bp) specificity, Lane 4: Multiplexing for GMO specific sequences (npt-II;215bp, P-e35S;195bp & T-nos,180bp), Lane 3 & 5: respective negative controls.

MON810. A longrun *cry1Ab* transgene cassette specific PCR assay developed with variable combinations of primer sets, facilitated assessment of structural integrity and stability of the entire transgene cassette of the GM maize. The reported protocol, hence, is an efficient and simple one to provide transgenic maize (MON810) detection under unified assay conditions and elicit all basic information pertaining to GM maize [C.K. Singh, A. Ojha, S. Kamle, D. N. Kachru (2007) Nature Protocols: (doi -10.1038/nprot.2007.440)].

3. Toxicological Implication of Food Adulterants/Contaminants

3.1 Adulteration of mustard cooking oil with argemone oil: Role of antioxidant therapy

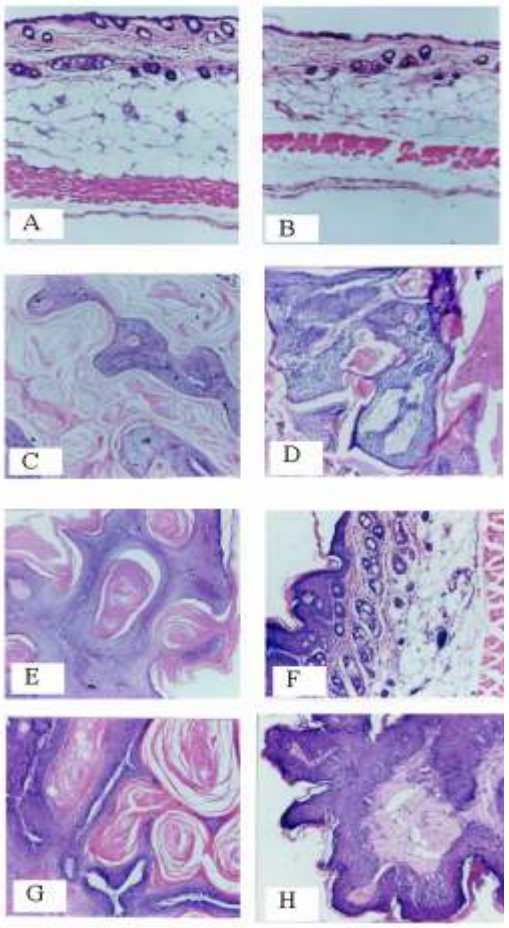
Consumption of mustard oil contaminated with argemone oil leads to a clinical condition called 'Epidemic Dropsy (ED)'. Earlier experimental studies have shown that argemone oil mediated hepato-toxicity is due to an increase in reactive oxygen species. Since glutathione system (GSH, GSSG), pyridine nucleotides (NAD, NADP, NADH, NADPH) and thiol groups are involved in a variety of free radical scavenging reactions and their redox potential plays an important role in protecting hemoglobin and erythrocyte membranes, these parameters along with α-tocopherol levels were investigated in the red blood cell (RBC) of ED patients from an outbreak at Lucknow and Patna cities of India. A significant ($P<0.05$) decrease in RBC count (27%) and Hb content (33%) was found in Lucknow dropsy patients, which was relatively more in Patna patients (61-66%). The ratio of GSSG/GSH in erythrocytes of Lucknow ED patients (3 fold) and Patna ED patients (14 fold) was found to be significantly ($P<0.05$) increased when compared to controls. The redox potential for GSH pool in RBC of Lucknow ED and Patna ED patients was found to be enhanced by +28 and +54 mV, respectively. Similarly NADH and NADPH contents in Lucknow ED patients (32-33%) and Patna ED patients (59-60%) showed substantial decrease along with inhibition of total antioxidant activity, indicating the pro-oxidant environment in dropsy patients. Enhanced pro-oxidant environment in Patna patients as compared to Lucknow patients may be due to the fact that antioxidant therapy including α-tocopherol was not given to Patna patients. Hence, antioxidant therapy may be beneficial to ED patients and needs detailed clinical trial in future [Ch.K. Babu, S.K. Khanna M. Das (2007) Antioxid Redox Signaling 9 : 515-525].



Redox potential values for glutathione pool in RBC and total antioxidant capacity in plasma of dropsy patients

3.2 Protective effect of *Ocimum sanctum* on 3-methylcholanthrene, 7, 12-Dimethyl benz(a)anthracene and aflatoxin B1induced skin tumorigenesis in mice

Studies on the mechanism of protective effect of extract of the leaves of *Ocimum sanctum* against chemical carcinogen induced skin tumorigenesis in a mouse model have been investigated. The study involved pretreatment of mice with the leaf extract either prior to 3-methylcholanthrene (MCA) application or tetradecanoyl phorbol acetate (TPA) treatment in a two stage tumor protocol vis a vis, 7,12-dimethylbenz(a)anthracene (DMBA)/TPA and aflatoxin B1 (AFB1)/TPA. The results of the present study indicate that the pretreatment with alcoholic extract of the leaves of *O. sanctum* decreased the number of tumors in MCA, DMBA/TPA and AFB1/TPA treated mice. The histopathological examination of skin tumors treated with Ocimum leaf extract showed increased infiltration of polymorphonuclear, mononuclear and lymphocytic cells with concomitant enhancement of interleukin-1 (IL-1) and tumor necrosis factor (TNF) in the serum, implying the in vivo antiproliferative and immunomodulatory activity of leaf extract. The decrease in the activities of Phase I enzymes and elevation of Phase II enzymes in response to topical application of this extract prior to MCA, AFB1, DMBA/ TPA and AFB1/ TPA treatment of animals indicates the possibility of impairment in reactive metabolite(s) formation and thereby reducing skin carcinogenicity. Further, pretreatment of leaf extract in the carcinogen induced animals resulted in elevation of glutathione levels and decrease in



Photomicrograph of skin showing normal histological structure in (a) control and (b) leaf extract treated animal; (c) squamous cell carcinoma with extensive keratin pearl formation in MCA treated group; (d) marked infiltration of polymorphonuclear lymphocytes as well as lymphocytes including necrosis and reduced keratin pearl formation in group treated twice weekly application of leaf extract along with MCA; (e) squamous cell carcinoma with proliferation of epidermal layers and extensive keratin pearl formation in DMBA/ TPA treated group (f) skin of mice initiated with DMBA and treated twice weekly with leaf extract and TPA demonstrated reduced papillomatous projection and limited keratin pearl formation; (g) squamous cell carcinoma and pearl formation in AFB1 / TPA treated group and (h) twice weekly treatment with leaf extract to AFB1/TPA treated animals showed limited tumor growth lacking pearl formation and hyperkertinization (H&E, X115).

lipid peroxidation and heat shock protein expression, indicating a scavenging or antioxidant potential of the extract during chemical carcinogenesis. These results imply that leaf extract of *O. sanctum* provides protection against chemical carcinogenesis in one or more of the following mechanisms: (i) by acting as an antioxidant; (ii) by modulating phase I and II enzymes; (iii) by acting as an immunomodulator leading to antiproliferative activity [S. Rastogi, Y. Shukla, B. N. Paul, D. K. Chawdhuri, S.K. Khanna, M. Das (2007) Toxicol App Pharmacol 224: 228-240]

3.3 Exposure assessment to Sudan dyes through consumption of artificially coloured chilli powders in India

Spices Board of India formulated a mandatory testing programme for the detection of Sudan dyes in all chilli consignments exported from India. For this reason, 800 non-branded, loose chilli powder samples, were checked for the magnitude of artificial colouration and presence of Sudan dyes. Sixty six percent samples were found to contain artificial Sudan dyes while only 33% were free from it. None of the branded chilli powder sample, however, were found to contain Sudan dyes. The maximum content of Sudan I noted was as high as 11,767 µg/gm, which at the per capita consumption level of 0.5-1.0 gm chilli powder per day amounts to an intake of 5.85 -11.7 mg of Sudan I. These levels are expected to cause serious health consequences and should be strictly checked to safeguard the health of unsuspecting consumers [K.K. Mishra, S. Dixit, S.K. Purshottam, R.C. Pandey, M. Das, S.K. Khanna (2007) I J Food Sci Technol 42: 1363-1366].

3.4 Rampant use of non-permitted colours in eatables in both rural and urban areas

Synthetic colours are added to foods to replace natural colour lost during processing, to reduce batch-to-batch variation, and to produce products with consumer appeal where no natural colour exists. A study was carried out to find the type and level of synthetic food colours added to various eatables in the urban and rural areas of Lucknow. Inventory of coloured eatables showed that more types and varieties of coloured eatables were prevalent in the urban areas than in the rural areas. Of the total 1199 analyzed samples, 69% coloured eatables revealed the presence of permitted colours while 31% samples contained non-permitted colours. The use of non-permitted colours was found to be more in rural areas than in the urban areas. Also, more of the rural market samples contained permitted colours exceeding the maximum allowed prescribed levels as compared to urban markets. In urban areas, samples of crushed ice which are preferentially consumed by children population, the presence of Sunset Yellow FCF and Tartrazine was found to exceed the permissible limit by 8 and 20 times while in rural areas Sunset Yellow FCF, Tartrazine and Carmoisine exceeded the permissible limit by 23, 16 and 15 times, respectively. Non-permitted colours such as Rhodamine B, Metanil Yellow, Orange II, Malachite Green, Auramine, Quinoline yellow,

Amaranth and Sudan dyes were identified in various foodstuffs. The use of these dyes is more common in the rural markets than in the urban markets. Extensive food quality monitoring and surveillance programmes are needed for exposure assessment and to safeguard the health of population at large [M. Tripathi, S.K. Khanna, M. Das (2007) Food Control 18: 211-219].

4. Genetic Polymorphism in Indian Population - Its Role in Differential Toxic Response / Susceptibility to Disease

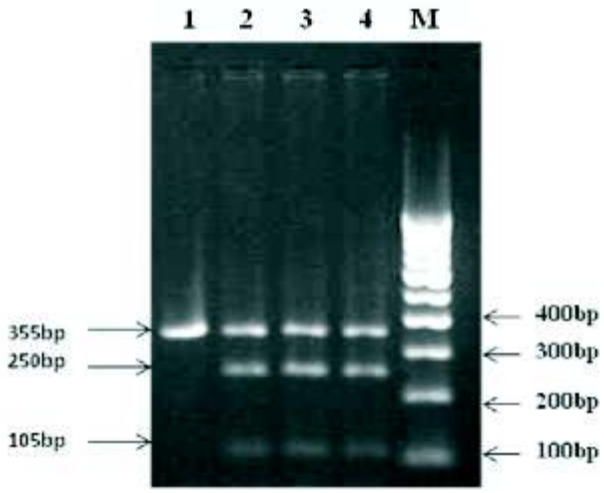
4.1 Functionally important polymorphisms in cytochrome P4501A1 and cytochrome P4501B1 and its association with lung cancer

Lung cancer is the most common cause of death throughout the world. Cigarette smoke has been established as the major etiological factor in this disease. Not all smokers, however, develop lung cancer. Polymorphism in drug metabolizing enzymes and their association with lung cancer risk in Indian population, was carried out in the present case-control study. Polymorphisms in drug metabolizing cytochrome P4501A1 (CYP1A1), CYP1B1 and glutathione S-transferase M1 (GSTM1) with risk to squamous cell carcinoma of lung malignancy was evaluated. Patients suffering from lung cancer (n=200) and visiting OPD facility of Department of Radiotherapy, Chhatrapati Shahuji Maharaj Medical University (CSMMU), Lucknow were included in the study. Equal number (n=200) of age and sex matched healthy individuals were also enrolled in the study. Data revealed that the variant genotypes of CYP1A1 (CYP1A1*2A, CYP1A1*2C, CYP1A1*4) and CYP1B1 (CYP1B1*2) were found to be over represented in the lung cancer patients when compared to controls. Likewise, GSTM1 null genotypes were found to be overrepresented in patients when compared to controls. Haplotype analysis revealed that CYP1A1 haplotype, C-G-C and CYP1B1 haplotypes (G-T-C-A, G-T-G-A and G-T-C-G) significantly increased the lung cancer risk in the patients. The lung cancer risk was increased several (2-4) fold in the patients carrying the genotype combinations of CYP1 A1*2A and GSTM1 or CYP1B1*2 and CYP1B1*3 with GSTM1 suggesting the role of gene-gene interaction in lung cancer. Cigarette smoking, tobacco chewing or alcohol consumption were also found to interact with CYP1A1and CYP1B1 genotypes in increasing the risk to lung cancer. Thus, it was

demonstrated that gene-environment interaction plays an important role in development of lung cancer [P. P. Shah, A. P. Singh, M. Singh, N. Mathur, B. N. Mishra, M. C. Pant, D. Parmar (2008) Mutat Res - FUND MOL M 643: 4-10; P. P. Shah, A. P. Singh, M. Singh, N. Mathur, J. T.M. Buters, M. C. Pant, D. Parmar (2008) Mutat Res - FUND MOL M 639: 1-10].

4.2 Genetic Polymorphism of CYP2D6 in Chronic Myeloid Leukemia patients

Chronic Myeloid Leukemia (CML) is a clonal hematopoietic stem cell disorder characterized by the Philadelphia chromosome and resultant production of the constitutively activated Bcr-Abl tyrosine kinase. The study was aimed to detect the prevalence of genetic polymorphism in the CYP2D6 gene in North Indian CML patients and racially matched controls, and to determine association of CYP2D6 allelic variants, if any, as risk factor to develop CML. The mutant CYP2D6*4 alleles were detected by PCR amplification using exon 3/intron 4 primers, followed by BstN1 digestion. In CML patients, CYP2D6*4 77% (35/45) were homozygous wild, 13% (6/45) heterozygous and 8% (4/45) homozygous mutant alleles. In controls the frequency of homozygous wild, heterozygous and homozygous mutant alleles was 75% (42/56),14% (8/56) and 10% (6/56) respectively. The results did not support the hypothesis that mutant alleles of CYP2D6*4 gene which are actively involved in activation of carcinogens will be at greater risk to develop CML [P. Bajpai, A. K. Tripathi, D. Agarwal, unpublished results].

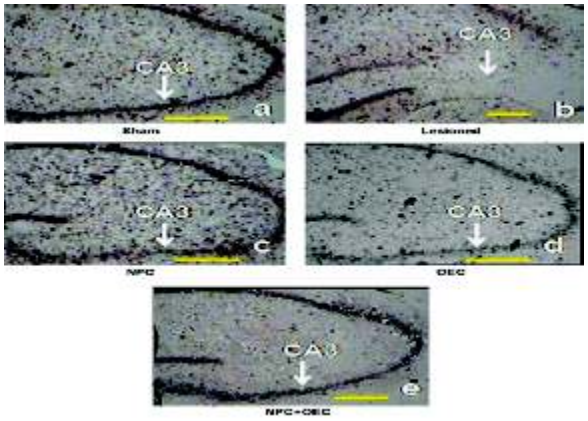


CYP2 D6*4 produces normal allele with two fragments of 250 and 105 bp after digestion with BstNI restriction enzyme. G to A base/nucleotide transition at position 1934 abolishes the restriction site and a fragment of 355 bp is observed. Lane 1 Homozygous mutant (3556 bp); Lane 2-4 Heterozygous genotype generated 355, 250 & 105 bp; M 100 base pair DNA Ladder

5. Molecular & Cellular Mechanisms Involved in Neurotoxicology

5.1 Long-term functional restoration by neural progenitor cell transplantation: Role of co-transplantation with olfactory ensheathing cells for neurotrophic factor support

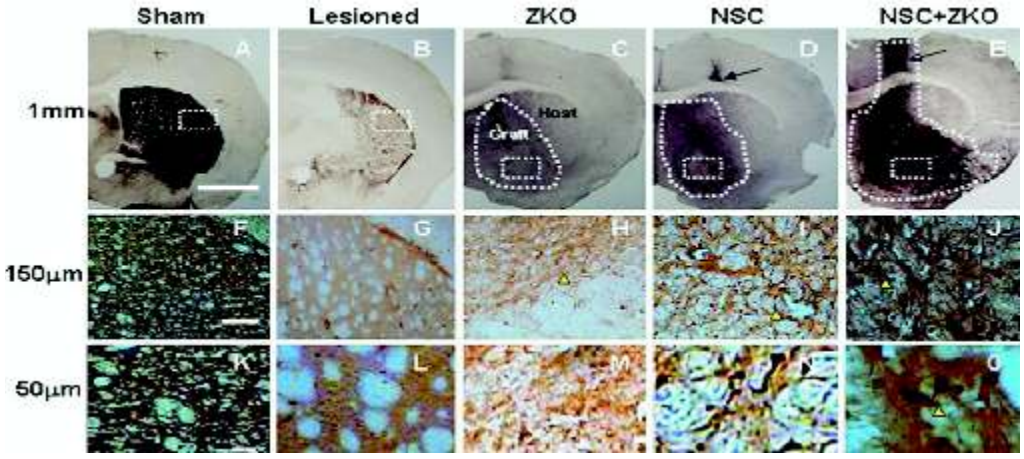
Neurotrophic factor secreting olfactory ensheathing (OECs) cells are suggested to support the long term survival of neural progenitor cell (NPCs) following neural transplantation. An attempt was made to validate functional restoration in kainic acid lesioned rat model of cognitive dysfunction following co-transplantation of NPCs + OECs. Animals lesioned with kainic acid in CA3 subfield of hippocampal region were transplanted with NPCs, OECs or NPCs+ OECs together. Twelve weeks post-transplantation functional restoration was assessed using neurobehavioral, neurochemical, and immunohistochemical approaches. Significant recovery in learning and memory (89%) was observed in co-transplanted group when compared to lesioned group. This was accompanied by significantly higher expression of choline acetyltransferase and restoration (61%) in cholinergic receptor binding in cotransplanted group. Role of OECs in supplementing neurotrophic factors was further substantiated in-vitro by pronounced differentiation of NPCs to choline acetyltransferase/acetylcholine esterase immunoreactive cells when co-cultured with OECs. The results suggest that co-transplantation of OECs and NPCs may be a better approach for functional restoration in kainic acid induced rat model of cognitive dysfunction [N. Srivastava, K. Seth, V. K. Khanna, R. W. Ansari, A. K. Agrawal (2008) Int. J. Devl Neuroscience; *in press*].



Photomicrograph of CA3 region of hippocampal sections illustrating ChAT-immunoreactive neurons. KA lesioned rates (b) had shown diminished ChAT immuno positivity as compared to sham (a). Lesioned rats transplanted with NPC (c), OEC (d) and NPC+OEC (e) has shown high expression of ChAT immunopositive cells in comparison to lesioned rats Scale bar = 350 µm.

5.2 Cografting with Zuckerkandl's organ improves long-term survival and function of neural stem cell derived dopaminergic neurons in 6-OHDA induced Parkinsonian rats

Transplantation of neural stem cell (NSC) derived dopamine (DA) neurons has emerged as a promising therapeutic approach in Parkinson's disease (PD). However,



Photomicrographs of TH immunoreactive neurons in lesioned rats striatum (B) as compared to sham (A) 24 weeks after transplantation. Surviving grafts are shown in all transplanted groups (C-E). Arrow show presence of transplanted cell (NSC) alone and NSC+ZKO co-tyransplanted group. F-J depicts an area selected in A-E as depicted as dotted square showing TH-IR fiber density and TH-IR neurons at higher magnification. K-O is further representation of F-J at higher magnification showing neurites extension, fiber innervation andTH positive cells bodies. Arrowheads indicate immunoreactivity for TH. Scale bar; Fig A-E=1 mm, F-J - 150 µm, K-O - 50 µm.

survival of these neurons following transplantation is limited due to limited striatal reinnervation, lack of continuous neurotrophic factors supply and principally an absence of cell adhesion molecules. In the present study, an attempt has been made to increase survival and function of NSC derived DA neurons, by co-grafting with Zuckerkandl's organ, ZKO (a paraneural organ that expresses neurotrophic factors as well as cell adhesion molecules), to provide continuous NTF support and developmental cues to transplanted DA neurons in rat model of PD. 24 weeks post-transplantation, significant number of surviving NSC derived DA neurons were observed in co-transplanted group as evident by increase in tyrosine hydroxylase immunoreactive (TH-IR) neurons, TH-IR fiber density, TH-mRNA expression and TH-protein level at the transplantation site (striatum) (Fig. II). Significant behavioral recovery (amphetamine induced stereotypy and locomotor activity) and neurochemical recovery (DA-D2 receptor binding and DA& DOPAC level at transplant site) was also observed in NSC+ZKO co-transplanted group. *In vivo* results were further substantiated by *in vitro* studies, which suggest that ZKO increase the NSC derived DA neuronal survival, differentiation, DA release and neurite outgrowth as well as protects against 6-OHDA toxicity in co-culture condition [R. K. Chaturvedi, S. Shukla, K. Seth, A. K. Agrawal (2008) Exp Neurol. 210: 608-623].

5.3 Anti-ischemic effect of curcumin in rat brain

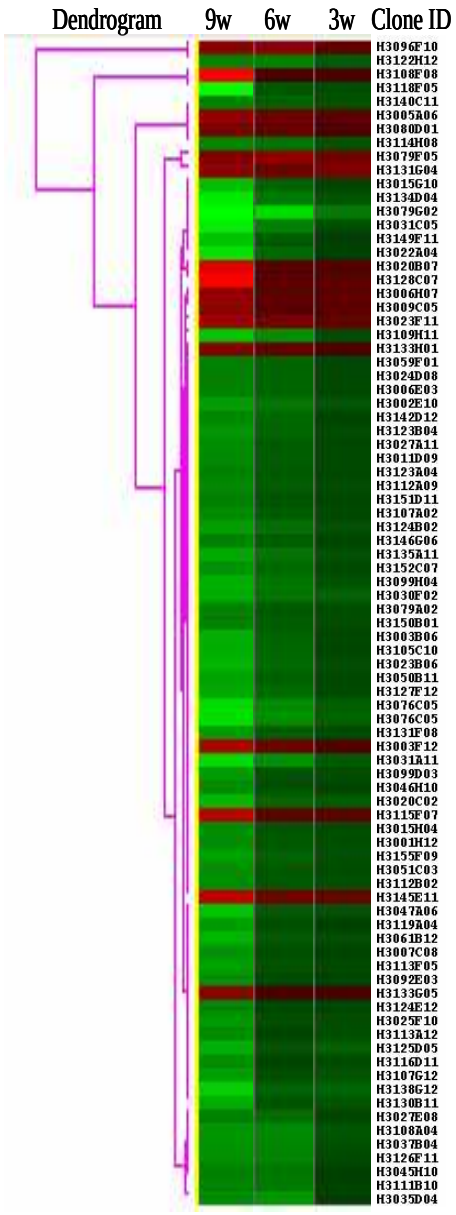
Turmeric due to its medicinal properties has been in use since ancient times as a condiment. Curcumin, the yellow colouring principle in turmeric, is polyphenolic and major active constituent. Besides anti-inflammatory, thrombolytic and anticarcinogenic activities,

curcumin also possesses strong antioxidant property. In view of the novel properties, neuroprotective efficacy of curcumin was studied in rat middle cerebral artery occlusion (MCAO) model. Rats were subjected to 2 h of focal ischemia followed by 72 h of reperfusion. They were pre-treated with curcumin (100 mg/kg, po) for 5 days prior to MCAO and for another 3 days after MCAO. The parameters studied were behavioral, biochemical and histological. Treatment with curcumin could significantly improve neurobehavioral performance compared to untreated ischemic rats as judged by its effect on rota-rod performance and grid walking. A significant inhibition in lipid peroxidation and an increase in superoxide dismutase (SOD) activity in corpus striatum and cerebral cortex was observed following treatment with curcumin in MCAO rats as compared to MCAO group. Intracellular calcium levels were decreased following treatment with curcumin in MCAO rats. Histologically, a reduction in the infarct area from 33% to 24% was observed in MCAO rats treated with curcumin. The study demonstrates the protective efficacy of curcumin in rat MCAO model [P. K. Shukla, V. K. Khanna, Mohd. M. Ali, Mohd. Y. Khan, R. C. Srimal (2008) Neurochemical Res 33:1036-1043].

5.4 Persistence in alterations in the ontogeny of cerebral and hepatic cytochrome P450s and their responsiveness following prenatal exposure to low doses of 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 b. wt., corresponding to 1/1400th, or 1/700th or 1/350th of LD_{50}) of lindane to pregnant dams from gestation day (GD) 5-21 produce dose-dependent alterations in the ontogenic profile of xenobiotic metabolizing cytochrome P450s (CYPs) in the brain and liver of offspring. The increase in the cerebral and hepatic mRNA expression of CYP1A1, 1A2, 2B1, 2B2 and 2E1 was also found to be associated with an increase in the catalytic activity of these CYP isoenzymes in the brain and liver of the offspring at different stages during postnatal development. Interestingly, though the levels of CYPs were several fold lower in brain when compared to the liver, almost equal magnitude of induction in these CYPs in brain have suggested that like in the liver, brain CYPs are responsive to the transplacental induction by environmental chemicals and that the increase is transcriptionally regulated. Moreover, due to its lipophilic nature, lindane may partition in mother's milk leading to further exposure of the offspring during the critical period of neurodevelopment which may explain the increase in CYP mRNA expression and associated catalytic activity especially during the early postnatal period. Interestingly, the increase in mRNA expression of these CYP isoforms was found to persist upto adulthood, suggesting that the low doses of lindane administered to the dams might program the brain and liver of the offspring to permanently overexpress the xenobiotic metabolizing CYP isoforms [A. Johri, A. Dhawan, R. L. Singh and D. Parmar (2008) Toxicol Sci 101: 331-340].

Further, to investigate the responsiveness of CYPs in offspring prenatally exposed to lindane (0.25 mg/kg b. wt.; 1/350th of LD_{50}; p. o. to mother), offsprings were challenged with 3-methylcholanthrene (MC) or phenobarbital (PB), inducers of CYP1A and 2B families or a sub-convulsant dose of lindane (30 mg/kg b. wt., p. o.) later in life. A much higher increase in expression of CYP1A and 2B isoenzymes and their associated catalytic activity was observed in animals pretreated prenatally with lindane and challenged with MC (30 mg/kg, i. p. x 5 days) or PB (80 mg/kg, i. p. x 5 days) when young at age (approx. 7 weeks) compared to animals exposed to MC or PB alone. Further, challenge of the control and prenatally exposed offspring with a single sub-convulsant dose of lindane resulted in an earlier onset and increased incidence of convulsions (8/10 vs 5/10)) in the offspring prenatally exposed to lindane. The data assume significance as the subtle changes in the expression profiles of hepatic and cerebral CYPs in rat offspring during postnatal development could modify the adult response to a later exposure to xenobiotics [A. Johri, S. Yadav, A. Dhawan and D. Parmar (2008) Toxicol Appl Pharmacol 231: 10-16].



Clustered display of data obtained from the mouse striatum treated with maneb + paraquat for 3, 6 and 9 weeks. Red indicates upregulated and green represents downregulated transcripts following exposure to maneb and paraquat. Each transcript (clone/gene) ID and time point is mentioned in the figure. For checking of the accuracy of arrangement of transcripts in clustered display, one transcript (H3076C05) is repeated

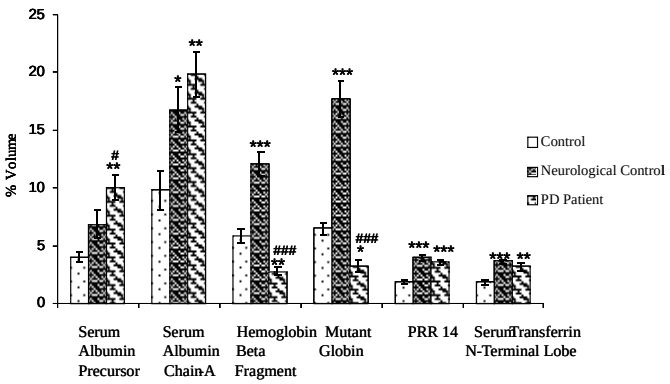
5.5 Gene expression profiles of mouse striatum in control and maneb + paraquat-induced Parkinson's disease phenotype: A microarray based approach

The study was initiated to investigate the gene expression patterns of the striatum of control and maneb + paraquat-induced Parkinson's disease (PD) phenotype in mouse to identify the differentially expressed transcripts. The animals were treated with and without maneb (30 mg/kg, i.p) + paraquat (10 mg/kg, i.p.), twice a week, for 3, 6 and 9 weeks. The RNA was isolated from control and treated mouse striatum, reverse transcribed and equal quantities of labeled cDNA were mixed and

hybridized with mouse 15k arrays. Comparative transcription patterns showed a time of exposure dependent alteration in the expression of transcripts associated with several pathways i.e., oxidative stress, energy metabolism, cell cycle regulation, cell adhesion and apoptosis etc. RT-PCR reconfirmed the differential expression of some energy metabolizing transcripts. The study provides maneb + paraquat-induced differential expression of many transcripts using high-density microarray approach. The results obtained suggest that maneb + paraquat induce neurotoxicity in the striatum in a time of exposure dependent manner via multiple pathways and defective energy metabolism could play a critical role [S. Patel, K. Singh, S. Singh, M. P. Singh (2008) Mol Biotechnol 40: 59-68]

5.6 Proteomic identification of differentially displayed proteins in cerebrospinal fluid of Parkinson's disease patients

Clinical proteomics has been widely used to identify differentially displayed proteins in blood and cerebrospinal fluid (CSF) to understand the molecular and cellular events leading to Parkinson's disease (PD). The close connection between CSF and the brain offers reliable and reproducible way to assess the majority of changes in the brain proteome profile directly into CSF throughout the course of neurodegeneration. The present study was undertaken to identify the differentially displayed proteins in CSF of PD patients as compared with controls using two-dimensional polyacrylamide gel electrophoresis (2-D PAGE) and mass spectrometry. Comparative 2-D PAGE electrophoretograms of CSF of PD patients with case controls and/or neurological controls revealed significant differential display of six protein spots. The differentially displayed proteins were identified as serum albumin precursor, serum albumin chain-A, hemoglobin beta fragment, mutant globin, proline rich repeat 14 (PRR 14) and serum transferrin N-terminal lobe. Although the level of hemoglobin beta fragment and mutant globin was attenuated, serum albumin precursor, serum albumin chain-A, PRR 14 and serum transferrin N-terminal lobe were augmented in PD patients as compared with case controls. The level of serum albumin chain-A, PRR 14 and serum transferrin N-terminal lobe was



Changes in percent volume of serum albumin precursor, serum albumin chain A, hemoglobin beta chain, mutant globin, PRR 14 and serum transferrin N-terminal lobe in study group. The values are expressed as means + S.E.M. and significant changes *, ** and *** (p values: < 0.05, 0.01 and 0.001) are expressed against controls and # and ### (p values: < 0.05 and 0.001) against neurological controls.

not significantly altered when compared with neurological controls. The results obtained thus suggest that differential display of CSF serum albumin precursor, serum albumin chain-A, PRR 14 and serum transferrin N-terminal lobe could be associated with neuronal dysfunction and hemoglobin/globin with the onset/progression of PD in humans [A. Sinha, N. Srivastava, S. Singh, A. K. Singh, S. Bhushan, R. Shukla, M. P. Singh (2008) Clin Chim Acta; *in press*].

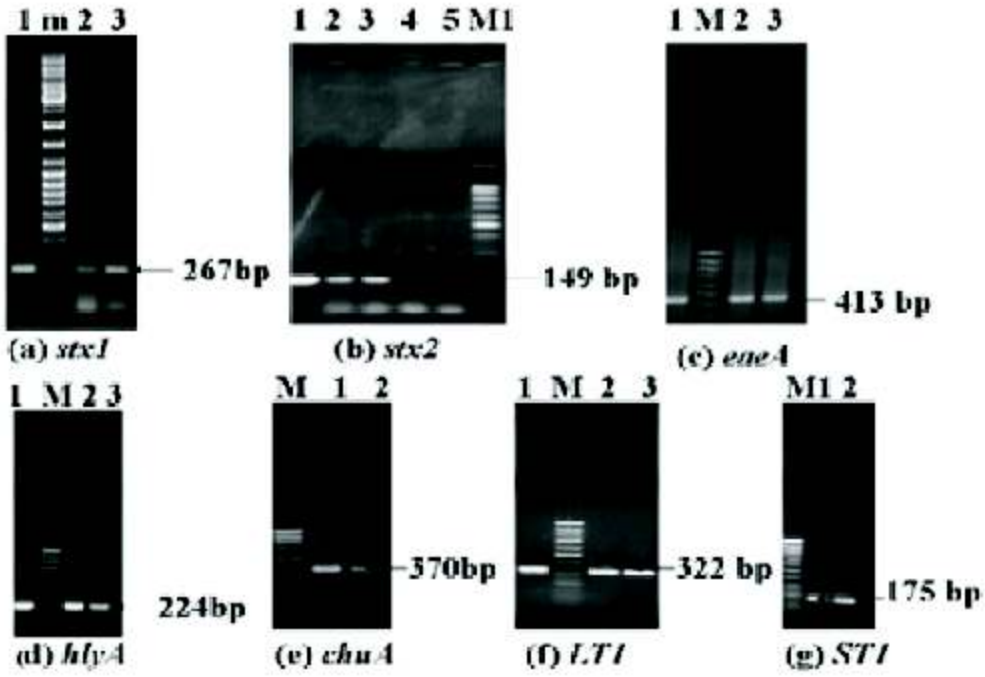
6. Water Quality Assessment, Monitoring and Mitigation

6.1 Contamination of potable water distribution systems by multiantimicrobial-resistant enterohemorrhagic *Escherichia coli*

The contamination of processed or unprocessed drinking water by fecal coliform bacteria has been reported worldwide. Despite a high incidence of waterborne diseases, Enterohemorrhagic *Escherichia coli* (EHEC) is an under acknowledged pathogen of concern to public health in India. Although the presence of EHEC is recorded in surface water resources of India, drinking water sources are yet to be investigated. The goal of this study was to analyze potable water samples for the presence of virulence determinants of EHEC and to determine the sensitivity of the virulence determinants to antimicrobials. Coliform bacteria were enumerated in potable water samples collected from six locations in Lucknow by using the most probable number method. *E. coli* (n = 81), randomly isolated by membrane-filtration technique from four sites, were identified by biochemical characterization. *E. coli* were not detected in samples from two other sites. We screened 15 randomly selected isolates from each site for virulence determinants of EHEC using polymerase chain reaction (PCR). The isolates positive for virulence determinants (n = 18) were screened for sensitivity to 15 antimicrobials by the disk diffusion method. Both *stx1* and *stx2* genes were present in 33.3% of isolates, whereas others possessed either *stx1* (11.1%) or *stx2* (55.6%). *eaeA*, *hlyA*, and *chuA* genes were present in 100, 23.3, and 16.7% of isolates, respectively. Resistance to multiple antimicrobials was observed in potential EHEC. The occurrence of multi antimicrobial-resistant EHEC in potable water is an important health concern because of the risk of waterborne outbreaks [S. Ram, P. Vajpayee, R. Shanker (2008) Environ Hlth Perspect 116: 448-452].

6.2 Prevalence of multi-antimicrobial-agent resistant, Shiga toxin and enterotoxin producing *Escherichia coli* in surface waters of river Ganga

The consumption of polluted surface water for domestic and recreational purposes by large populations in developing nations is a major cause of diarrheal disease related mortality. The river Ganga and its tributaries meet 40% of the water requirement for drinking and irrigation in India. In this study, *Escherichia coli* isolates ((n) 75) of the river Ganga water 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 Ganga water exhibit resistance to multiple antimicrobial agents. The distribution of antimicrobial resistance in *E. coli* varies significantly (ø2: 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 Ganga water poses increased risk of infections in the human population [S. Ram, P. Vajpayee, R. Shanker (2007) Environ Sci Technol 41: 7383-7388].



PCR amplicons of virulence genes determined in *E.coli* isolates from surface water of river Ganga

([a] *stxl, lanel. positive control, E. coli ITRC-18, lane m: 1 Kb lodder* (MBI Fermentas), *lane 2*: M2D, *lane3:* M2B; [b] *stx2, lane1: positive control : E.coli* ITRC-18, *lane 2:* M2D, *lane 3:* M2B, *lane 4:* M3C, *lane 5:* L3A, *Lane M1:*100 bp + 1.5 Kb ladder (BioEnzyme); [c] eaeA, *lane 1 : positive control: E. coli* ITRC-18, *Lane M :* 100 bp ladder (MBI Fermentas), *lane 2:* M3C, *lane3:* M1B; [d] *hlyA, lanel: Lane M :* 100 bp ladder (MBI Fermentas), *lane 2: positive control: E. coli* ITRC-18, *Lane3:* M2B, [e] *chuA, lane M:* 100 bp ladder (MBI Fermentas), *lane 2:* R2A, *Lane3:* M2E; [g] *ST1 lane* M: 100 bp ladder (MBI Fermentas), *Lane 2: positive control: E. coli MTCC-723, lane 3:* R2A.

6.3 Evaluation of bactericidal efficacy of silver for disinfection of drinking water

Water borne infectious diseases such as gastroenteritis, cholera, dysentery, typhoid, hepatitis, polio etc., are caused due to consumption of drinking water contaminated with pathogenic microorganisms causing millions of deaths. Therefore, disinfection of drinking water is necessary as preventive measure. There are number of methods viz. filtration, chlorination, ozonization, UV radiation and reverse osmosis for disinfection of drinking water. At present, globally practiced method for disinfection of drinking water is chlorination which has been reported to form carcinogenic/mutagenic disinfection by-products (DBPs) such as trihalomethanes. Use of silver with oligodynamic and microbicidal properties has been found suitable and safe for public health as well as environment. Thus, study has been conducted to establish the bactericidal efficacy of silver ions for disinfection of drinking water. Fresh culture of *Escherichia coli* (approximately 6.5 X 103 colony forming units/ml) was exposed to 0, 2, 4, 6, 8 and 10 ppb of silver ion (from silver nitrate) at the ambient condition in 100 ml of autoclaved tap water. Survival of bacteria was determined by spread plate method on MacConkey agar after 30, 60, 90, 120 and 150 minutes of silver exposure. Total disinfection was observed at 8 ppb and 10 ppb of silver ion concentrations after exposure of 120 minutes and 60 minutes, respectively.

6.4 Biological materials are potential adsorbents of hexavalent chromium

Hexavalent chromium Cr(VI) introduced into the aquatic ecosystem is serious concern due to its toxic effect. Number of treatment methods for the removal of Cr(VI) from aqueous solutions have been reported, mainly reduction, ion exchange, electrodialysis, electrochemical precipitation, evaporation, solvent extraction, reverse osmosis and chemical precipitation. However, presently no viable and cost effective technology is commercially available to remove Cr from the water. Activated carbons of groundnut husk and Eucalyptus bark have been developed and screened for their efficacy to remove Cr(VI) from aqueous solution through batch and column experiments. Thermodynamic parameters viz. entropy change, enthalpy change and Gibbs free energy change of adsorbents were found to be 1.68 kJ mol-1 K-1, 0.46 kJ mol-1 -4.38 kJ mol-1, and 1.39 kJ mol-1 K-1, 1.08 kJ mol-1 and 3.85 kJ mol-1, respectively. Results revealed that adsorption of Cr (VI) on these carbons were endothermic in nature. The Langmuir and Freundlich equations were applied to describe the data derived from the adsorption of Cr by each adsorbent over the entire concentration range studied. Various concentrations of Cr(VI) were selected for the fixed bed adsorption studies. The surface properties of sorbent were characterized by the Scanning

electron microscopy (SEM), Electron Dispersive X-Ray Spectroscopic analysis (EDX), Fourier Transform Infrared Spectroscopy (FTIR), surface area analyser and porositimeter (Application of natural adsorbent from silver impregnated groundnut husk based thereon in the processes of hexavalent chromium for the purification of water, Journal of Hazardous Material, In press, 2008). Eucalyptus bark (0.2 gm/100 ml) showed 80% removal of Cr (VI) after 5 hr., while activated carbon of silver impregnated groundnut husk (0.5 gm/100) exhibited 95% removal of Cr(VI) after 5 hr. The results suggest that the adsorbents tested have potential to remove Cr(VI) from water at optimum conditions.

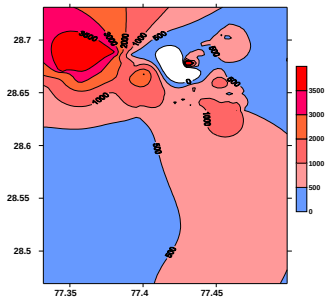
6.5 Development and Validation of Modeling-based Analytical Methods for Chemical Contaminants

A direct method for the determination of pyridine in water and wastewater based on ultraviolet spectrophotometric measurements using multi-way modeling techniques has been developed. Parallel factor analysis (PARAFAC) and multi-way partial least squares (N-PLS) regression methods were employed for the decomposition of spectra and quantification of pyridine. The study was carried out in the pH range of 1.0 to 12.0 and concentration range of 0.67 to 51.7 g mL-1 of pyridine. Both the three-way PARAFAC and tri-PLS1 models successfully predicted the concentration of pyridine in synthetic (spiked) river water and field wastewater samples. The mean recovery obtained from PARAFAC regression model were 97.39% for the spiked and 99.84% for the field wastewater samples, respectively. The sensitivity and precision of the method for pyridine determination were 0.58 and 5.95%, respectively. The N-PLS regression model yielded mean recoveries of 99.29% and 100.18% for the spiked and field wastewater samples, respectively. The prediction accuracy of the methods was evaluated through the root mean square error of prediction (RMSEP). For PARAFAC, it was 0.65 and 0.82 g mL-1 for spiked river water and field wastewater samples, respectively, while for N-PLS, it was 0.25 and 0.37 g mL-1, respectively. Both the PARAFAC and N-PLS methods, thus, yielded satisfactory results for the prediction of pyridine concentration in water and wastewater samples. The chemometric assisted spectrophotometric method can be used for the determination of pyridine in water and wastewater samples.

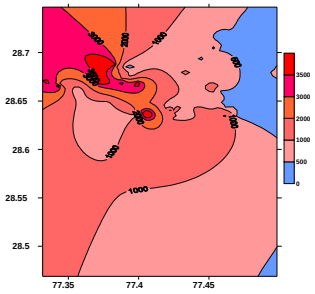
6.6 Sustainable development and management of water resources in different problematic terrains.

Identified groundwater/surface water sampling sites in industrial areas of Ghaziabad city and collected preliminary information.

- Collected post-monsoon (2007) and pre-monsoon (2008) samples from different sites in the selected study areas of Ghaziabad city. The samples statistics is given as below:

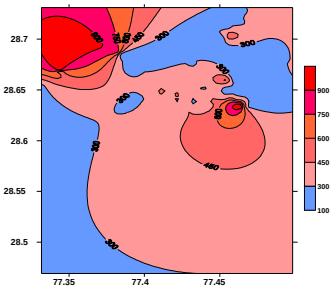


Post-Mononsoon (2007)

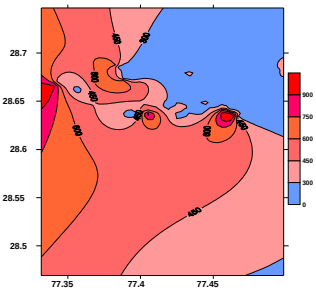


Pre-Monsoon (2008)

TDS in Ghaziabad Groundwater during the post- and pre-monsoon seasons.

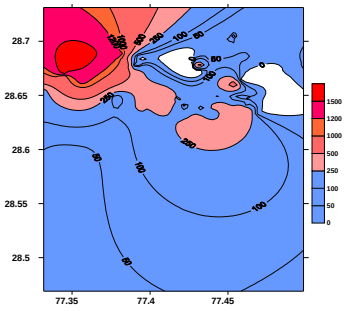


Post-Mononsoon (2007)

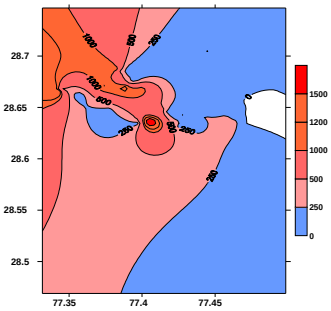


Pre-Monsoon (2008)

Total hardness in Ghaziabad Groundwater during the post- and pre-monsoon seasons.

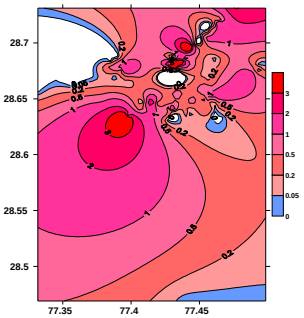


Post-Mononsoon (2007)

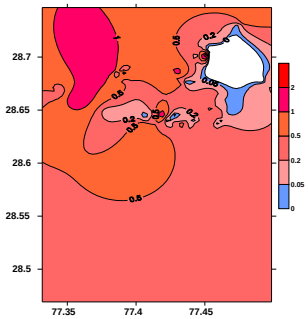


Pre-Monsoon (2008)

Chloride in Ghaziabad Groundwater during the post- and pre-monsoon seasons.



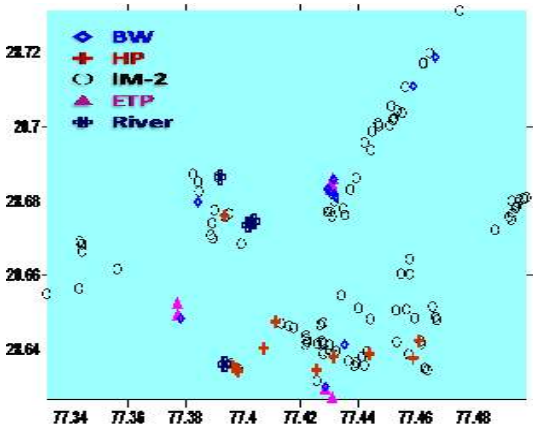
Post-Mononsoon (2007)



Pre-Monsoon (2008)

Chromium (T) in Ghaziabad Groundwater during the post- and pre-monsoon seasons.

- Performed on-site GPS measurements in the study areas.
- The samples were processed and analysed for various physic-chemical parameters, heavy metals and selected organo-chlorine pesticides. Groundwater quality of the Ghaziabad city in terms of some of the selected parameters is given below.



Season	Groundwater				Surface Water
	HP	BW	IM-2	Total	
Post-Mon 2007	12	12	97	121	4
Pre Mon 2008	11	8	98	117	4

Sampling network in Ghaziabad city

6.7 Development of low cost adsorbents for water / waste water decontamination

Physical and chemical properties of activated carbons prepared from coconut shells (SAC and ATSAC) were studied. The adsorption equilibria and kinetics of phenol and 2,4-dichlorophenol from aqueous solutions on such carbons were then examined at three different temperatures (10, 25 and 40 °C). Adsorption of both phenol and 2,4-dichlorophenol increased with an increase in temperature. The experimental data were analyzed using the Langmuir and Freundlich isotherm models. Both the isotherm models adequately fit the adsorption data for both the phenols. The carbon developed through the acid treatment of coconut shells (ATSAC) exhibited relatively higher monolayer adsorption capacity for phenol (0.53 mmol g^{-1}) and 2,4-dichlorophenol (0.31 mmol g^{-1}) as compared to that developed by thermal activation (SAC) with adsorption capacity of 0.36 and 0.20 mmol g^{-1}, for phenol and 2,4-dichlorophenol, respectively. The equilibrium sorption and kinetics model parameters and thermodynamic functions were estimated and discussed. The thermodynamic parameters (free energy, enthalpy and entropy changes) exhibited the feasibility and spontaneous nature of the adsorption process. The sorption kinetics was studied using the pseudo-first-order and second-order kinetics models. The adsorption kinetics data for both the phenol and 2,4-dichlorophenol fitted better to the second-order model. An attempt was also made to identify the rate-limiting step involved in the adsorption process. Results of mass transfer analysis suggested the endothermic nature of the reaction and change in the mechanism with time and initial concentration of the adsorbate. The results of the study show that the activated carbons derived from coconut shells can be used as

potential adsorbent for phenols in water/ wastewater [K.P. Singh, A. Malik, S. Singh, P. Ojha (2008) J Hazard Materials 150: 626-641].

A variety of low cost activated carbons were developed from agricultural waste materials viz., coconut shell, coconut shell fibers and rice husk. The low cost activated carbons were fully characterized and utilized for the remediation of various pollutants viz., chemical oxygen demand (COD), heavy metals, anions, etc., from industrial wastewater. Sorption studies were carried out at different temperatures and particle sizes to study the effect of temperatures and surface areas. The removal of chloride and fluoride increased with rise in temperature while COD and metal ions removal decreased with increase in temperature, thereby, indicating the processes to be endothermic and exothermic, respectively. The kinetics of COD adsorption was also carried out at different temperatures to establish the sorption mechanism and to determine various kinetic parameters. The COD removal was 47–72% by coconut shell fiber carbon (ATFAC), 50–74% by coconut shell carbon (ATSAC) and 45–73% by rice husk carbon (ATRHC). Furthermore, COD removal kinetics by rice husk carbon, coconut shell carbon and coconut fiber carbon at different temperatures was approximately represented by a first order rate law. Results of this fundamental study demonstrate the effectiveness and feasibility of low cost activated carbons. The parameters obtained in this study can be fully utilized to establish fixed bed reactors on large scale to treat the contaminated water [D. Mohan. K.P. Singh, V.K. Singh (2008) J Hazard Materials 152: 1045-1053].

6.8 Assessment of the Gomti river quality

Under this continued project, the water and sediments quality of the Gomti River was monitored at ten different locations between Neemsar and Jaunpur (Map) with a view to establish the baseline database for developing river pollution control strategies in the basin. A Neural Networks Networks (ANN) model was developed, calibrated, validated and applied to the river water quality data for prediction of the water quality.

Organochlorine pesticides residues in fish collected from the Gomti river were studied for assessment of the risk to the consumers. This study reports the levels and distribution patterns of some organochlorine pesticides (OCPs) in fish samples of the Gomti river, India, collected from three sites. In the fish muscles POCPs ranged between 2.58–22.56 ng g–1 (mean value: 9.66 ± 5.60 ng g–1). Neither spatial nor temporal trends could be observed in distribution of the OCPs. Aldrin was the predominant OCP, whereas, HCB and methoxychlor could not be detected. Alpha-HCH and beta-HCH among the isomers of HCH and pp-DDE among the metabolites of DDT were the most frequently detected OCPs. The results revealed that the fish of the Gomti river are contaminated with various OCPs [A. Malik, K.P. Singh, P. Ojha (2007) Bull Environ Contam Toxicol 78: 335–340].

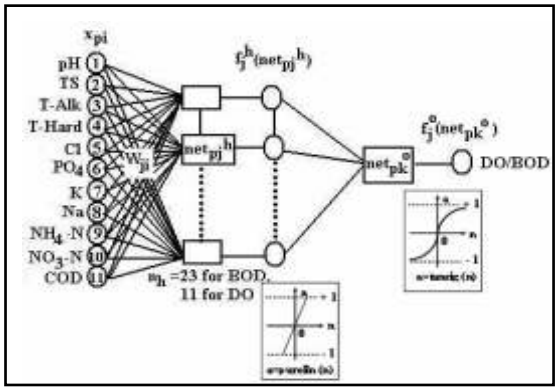
Distribution of Polycyclic Aromatic Hydrocarbons in Fish from Gomti River was

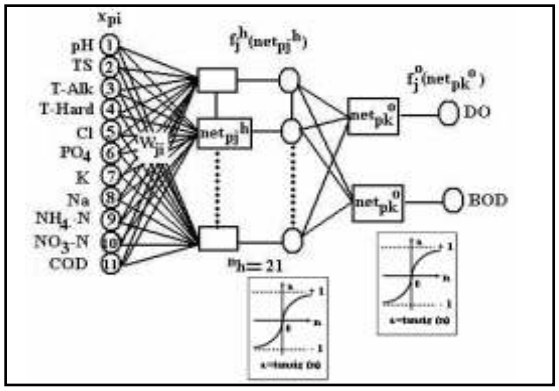
studied to assess the exposure risk to consumers. This study reports the levels and distribution patterns of selected polycyclic aromatic hydrocarbons (PAHs) in fish samples of the Gomti river, India, collected from three sites during the pre- and post-monsoon seasons of the years 2004–2005. In the fish muscles, PPAHs ranged between 12.85 and 34.89 ng g-1 wet wt (mean value: 23.98 ± 6.70 ng g-1). Naphthalene was the most prevalent compound both in terms of detection as well as levels, while, benzo(k) fluoranthene, benzo(a)pyrene, and indeno(123-cd)pyrene + benzo(ghi)perylene could not be detected in any of the sample. Low-molecular weight PAHs were observed to be dominating over the high molecular weight PAHs [A. Malik, P. Ojha, K. P. Singh (2008) India Bull Environ Contam Toxicol 80: 134-138].

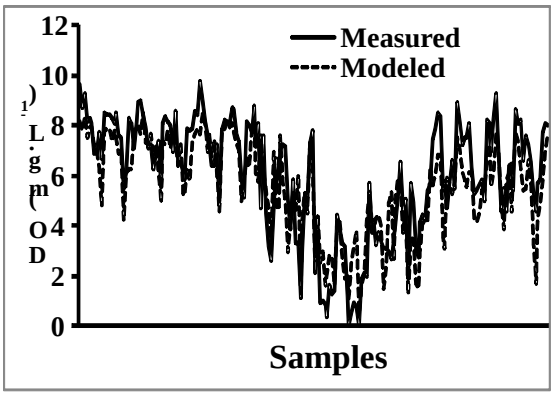
6.9 Artificial Neural Network (ANN) modeling for river water quality prediction

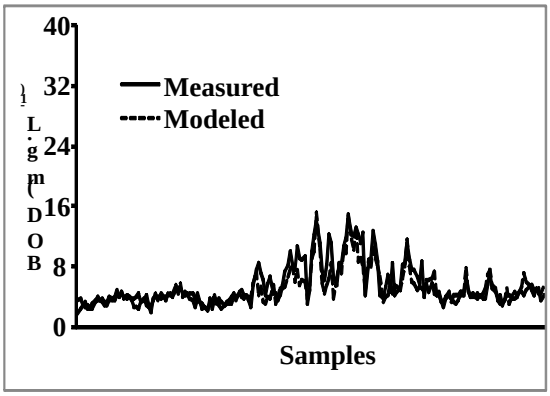
The artificial neural network, as the name implies, employs the model structure of a neural network which is very powerful computational technique for modeling complex non-linear relationships particularly in situations where the explicit form of the relation between the variables involved is unknown.

Here, three ANN models were developed, validated and tested for separate and simultaneous predictions of DO and BOD levels in the Gomti river water at different locations. All the three models (as below) employed eleven input water quality variables measured in river water over a period of ten years each month at eight different sites.









The performance of the ANN models was assessed through the coefficient of determination (R2), root mean square error (RMSE) and bias computed from the measured and model-predicted values of the dependent variables. Goodness of the model fit to the data was also evaluated through the relationship between the residuals and model predicted values of DO and BOD. The model predicted values of DO and BOD by all the three ANN models were in close agreement with their respective measured values in the river water.

Relative importance and contribution of the input variables to the model output was evaluated through the partitioning approach. The developed ANN models can be used as tools for the water quality prediction.

6.10 Multi-way data modeling

Groundwater hydrochemistry of the alluvial aquifers was investigated using the multi-way data 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 with the purpose of extracting the information on spatial and temporal variation trends in groundwater composition. Three-way data modeling was performed using PARAFAC and Tucker3 models. The models were tested for their stability and goodness of optimal fit using core consistency diagnostic and split-half analysis. Although, a two-component PARAFAC model, explaining 50.47% of data variance, yielded 100% core consistency, it failed to qualify the validation test. Tucker3 model (3, 3, 1) captured 55.18% of the data variance and yielded simple diagonal core with three significant elements, explaining 100% of the core variability. Interpretation of 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 are contaminated with nitrate derived from fertilizers application in the region. The shallow aquifers are relatively more contaminated during the post-monsoon season [K.P. Singh, A. Malik, S. Sinha, D. Mohan, V.K. Singh (2007) Anal Chim Acta 596:171-182].

6.11 Multi-Block data modeling

Source characterization of the soil contamination in Unnao region was performed using the multi-block data modeling approach. Multi-block (heavy metals, pesticides, physico-chemical parameters) data set pertaining to the soils of alluvium region in Indo-Gangetic plains was analyzed using principal component analysis (PCA) and multiple factor analysis (MFA) methods to delineate the contaminated sites and to identify the possible contamination sources in the study region. In normal PCA, the first three factors were

dominated mainly by heavy metals, pesticides and physicochemical variables, respectively, thus identifying samples/sites contaminated with these. The MFA results, due to its unique weighting scheme of variables of different blocks extracted, to more realistic information about the spatial distribution of samples and relationships among the variables. MFA minimized the influence of variables of one single block on the first few components, allowing variables of all blocks equally to share the common MFA space. This resulted in delineating the sites/regions contaminated with variables (Al, Co, Cu, Mn, Ni, Pb, V, Na, SO_4, aldrin, lindane, HCB, HCH, DDT, and endosulfan) of all the blocks, rather than by particular block variables as in case of normal PCA, where, the variables of single block dominate the first factors, suppressing other block variables. MFA which can be considered as a method for standardization of the multi-block variables was successfully applied to the three block data set of soils [K.P. Singh, A. Malik, S. Sinha, V.K. Singh (2007) Water Air Soil Poll 185: 79–93].

6.12 Atmospheric characterization and modeling

Hydrochemistry of the wet atmospheric precipitation over an urban area in northern Indo-Gangetic plains was investigated. Rain water samples were collected to study the chemical composition of wet atmospheric precipitation (first event) over the Lucknow city in the northern Indo-gangetic alluvial plains. The samples were collected in the month of July, 2005 from different sites. The wet precipitation samples were analyzed for pH, EC, major ions (HCO_3^-, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{2-}, F^-, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+) and heavy metals (As, Cd, Al, Co, Cr, Cu, Fe, Mn, Mo, Ni, Hg, Pb, Se, Sn, Ti, V, Zn). The pH values of wet precipitation samples ranged between 6.5 and 8.7. The analysis of linear regression applied to the set of studied variables and computation of neutralization factors showed that neutralization occurred in precipitation samples and Ca^{2+} had the maximum neutralization capacity. It was found that Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, Na^+ and K^+ in the precipitation samples originated mainly from crustal/ anthropogenic sources in the region. On an average Fe, and Al accounted for >72% of the total concentration of trace metals in the wet precipitation samples followed by Zn (>10%). Enrichment factors calculated for heavy metals over reference background level in seawater and Earth's crust showed relatively higher enrichment of Zn. The principal component analysis (PCA) identified the possible sources of ionic species and heavy metals in the wet precipitation samples.

The rainwater samples collected from the Lucknow city (India) were analyzed for selected organochlorine pesticides (OCPs) and polycyclic aromatic hydrocarbons (PAHs). HCH-isomers contributed most to the ΣOCPs with the highest levels of β-HCH isomer. The OCPs, which are currently banned in the country, were also observed. The residue levels of ROCPs in rainwater samples ranged between BDL and 447.17 ng L–1. Endrin,

β-endosulfan, heptachlor epoxide B and methoxychlor could not be detected in any of the sample. The levels of Σ PAHs in rainwater samples ranged between 19.32 and 11,112.09 ng L–1 and the most abundant hydrocarbon was acenaphthylene. Further, the lower molecular weight PAHs dominated over the high molecular weight compounds [K.P. Singh, V.K. Singh A. Malik, N. Sharma, R.C. Murthy, R. Kumar (2007) Environ Monit Assess 131: 237-254; A. Malik, V.K. Singh, K.P. Singh (2007) Bull Environ Contam Toxicol 79: 639–645].

7. Herbal Bioactivity and Safety Assessment

7.1 Safety evaluation of newly developed herbal health promoters/ formulations based on traditional knowledge

Positive Health Promoter (PHP) formulations have been developed under a network project for development of "Newer Scientific Herbal Preparations for Global Positioning" for (i) aged population; (ii) diabetes patients and (iii) breast 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 *in vivo* for anti-hyperglycemic and antioxidant activity. Individual extracts were subjected to fixed dose oral acute toxicity (OECD 420) and were found to be safe. Formulations comprising of these extracts prepared by the selected drug company is at present under evaluation for long term toxicity studies and *in vivo* antioxidant potential. Dossiers for these formulations have been prepared for regulatory agency and simultaneous clinical trials have been initiated.

In a separate study acute oral toxicity studies was carried out in 20 traditional Ayurvedic formulations. The samples studied were Avipatticar curna, Amalkyadi curna, Eladi curna, Talisadi curna, Narsimha curna, Navayasa curna, Pusyanuga curna, Jiraksarishta, Draksharishta, Drakasasawa, Parthyarishta, Balarishta, Plihari Vati, Rajah Prawartani Vati, Shankh Vati, and Sanjivani Vati. All the tested ayurvedic formulations were classified as category 5 as per Globally Harmonized System (GHS) of OECD (category 5: 2000 mg/kg<LD50 <5000 mg/kg: Outcome-C: No toxicity) found to be non-toxic in acute oral toxicity studies.

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

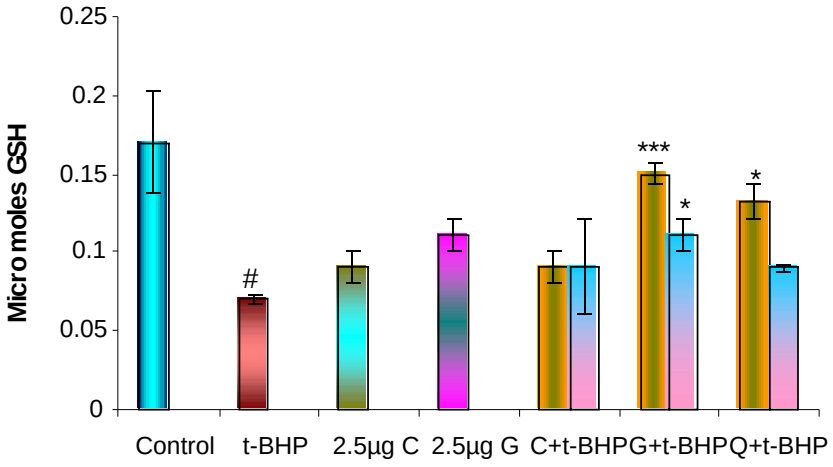
Golden Triangle Partnership project is a flagship project of CSIR to scientifically validate traditional medicine with an evidence-based approach and develop new formulations for 18 identified disease conditions. Medicinal plant samples (58) received under the project were tested for heavy metals and organochlorine pesticides before selection as raw material for formulations. The level of heavy metals and persistent pesticides in all the samples were found to be below the WHO permissible limits. Fixed dose acute oral toxicity studies were carried out for 8 herbal formulations i.e. GTP-0037, GTP-0050, GTP-0107, GTP-0111, GTP-0121, GTP-0122, GTP-0123 and GTP-0125. All the 8 formulations were found to be safe. Two formulations i.e. GTP-0037 for management of anxiety neurosis and GTP-0050 for management of Dyslipidemia, are under clinical trials. Three Herbo-metallic formulations i.e. Mahayogaraj Guggulu, Arogyavardhini vati and Mahalaxmi vilas rasa were also found to be safe when subjected to oral acute toxicity studies and sub-acute oral toxicity studies (28 days). Mahalaxmi vilas rasa has now been subjected to 90-days oral toxicity studies as per OECD guidelines to check any adverse effect of this heavy metal containing herbo-mineral formulation on long term usage.

7.3 *Bacopa monnieri* modulates antioxidant responses in brain and kidney of hyperglycemic rats

Role of oxidative stress has been reported in various diabetic complications including neuropathy, nephropathy and cardiopathy. This study was undertaken to evaluate the protective effect of *Bacopa monnieri*, a medicinal plant, on tissue antioxidant defense system and lipid peroxidative status in streptozotocin-induced diabetic rats. Extract of *B. monnieri* was administered orally, once a day for 15 days (at doses 50, 125 and 250 mg/(kg bw)) to diabetic rats. Activity of antioxidant enzymes (SOD, Catalase, and GPx), levels of GSH and lipid peroxidation were estimated in kidney, cerebrum, cerebellum and midbrain of diabetic rats and compared to reference drug, Glibenclamide. Administration of plant extract to diabetic rats showed significant reversal of disturbed antioxidant status and peroxidative damage. Significant increase in SOD, CAT, GPx activity and levels of GSH was observed in extract treated diabetic rats. The present study indicates that extract of *B. monnieri* modulates antioxidant activity, and enhances the defense against ROS generated damage in hyperglycemic rats [R. Kapoor, S. Srivastava, P. Kakkar (2008) Environ Toxicol Pharmacol, doi:10.1016/j.etap.2008.08.007].

7.4 Protection accorded by geraniol and camphene to rat alveolar macrophages against tert-butylhydroperoxide induced oxidative stress

Exploration of antioxidants of plant origin and scientific validation of their efficacies has unravelled bioactives from natural sources. In this study, two terpenoids camphene and geraniol were assessed for their cytoprotective and antioxidant potential in the t-BHP stressed rat alveolar macrophages. Effect of these test substances along with a known plant derived antioxidant quercetin (positive control) was seen on cell viability and oxidative stress markers including effect on lipid peroxidation, SOD activity, GSH content, NO release, ROS production as well as on mitochondrial membrane potential. Both the test substances geraniol and camphene increased the cell viability by 49.42% ($p< 0.001$) and 64.73% ($p< 0.001$) respectively during pre-treatment of test compound. Camphene and geraniol showed 29% ($p< 0.05$) and 45% ($p< 0.05$) increase in SOD activity, increase in GSH content and restored the mitochondrial membrane potential during pre-treatment as



Modulation of GSH content during pre and post treatment of camphene (C+t-BHP), Geraniol (G+t-BHP) and Quercetin (Q+t-BHP) in alveolor macrophages stressed with t-BHP. 2.5µg of camphene(C) and Geraniol(G) without t-BHP treatment were also used and their effect on GSH content was seen as compared to untreated cells. # p<0.05,## p<0.01 and ### p<0.001 as compared to control cells, * p<0.05,** p<0.01 and *** p<0.001as compared to t-BHP stressed cells.

compared to stressed cells. Camphene and geraniol were found to significantly decrease lipid peroxidation. NO release (83.84% and 64.61%) and ROS generation in the pre-treated cells as compared to stressed cells was also lowered in the presence of test compounds. Results indicate the pharmacological potential of these phytochemicals in lung inflammatory diseases where oxidative stress is a critical control point [M. Tiwari, P. Kakkar, Toxicol In vitro; *in press*].

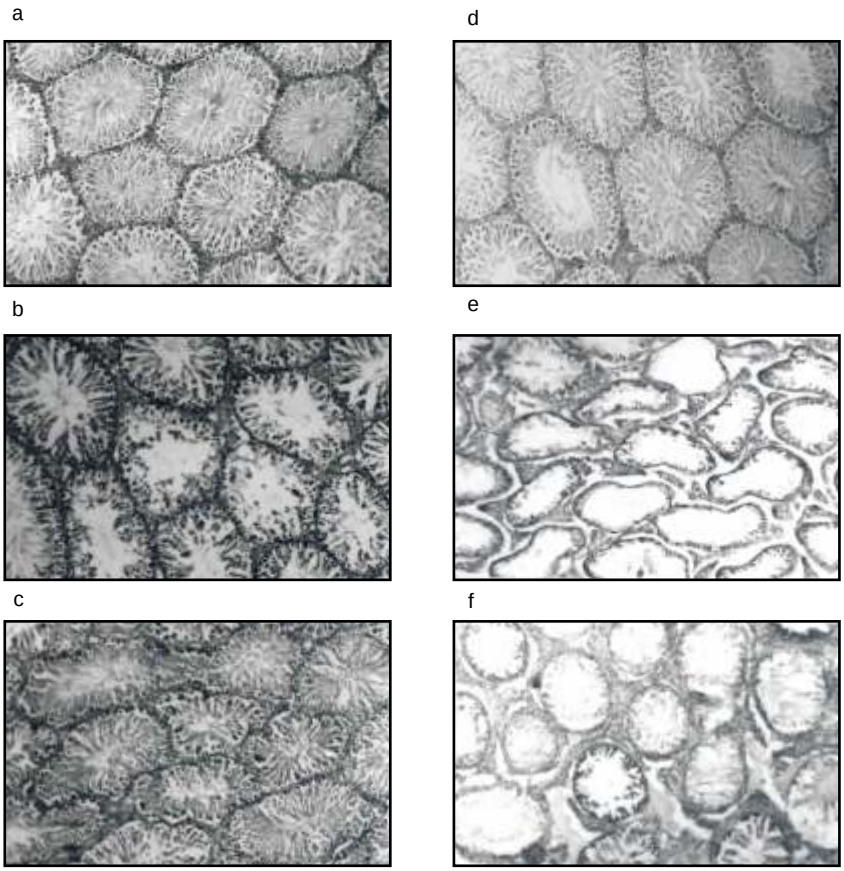
7.5 Toxicity studies of Neem product

The acute oral and dermal toxicity of neem kernel powder (NKP) to rat and mice have not shown any toxicological symptoms and mortality (Outcome-C) at the limit test dose of

2000 mg/kg body weight. Neem Kernal Powder has been classified as category 5 as per Globally Harmonized System (GHS) of OECD (category 5: 2000 mg/kg<LD50 <5000 mg/kg: Outcome-C: No toxicity). Neem kernel powder (NKP) was found to be non-irritant in primary skin irritation test to male and female rabbits and also non irritant to vaginal mucous membrane in rabbit.

7.6 Picroliv protects cadmium induced testicular damage in rat

Ameliorative potential of Picroliv, a standardized extract of *Picrorhiza kurroa* on Cd induced early and advanced testicular damage was investigated in male rats. In the former experiment, the rats were administered Cd as $CdCl_2$ (0.5 mg/kg, s.c.) 5 days/week for 18 weeks and Picroliv at two doses (6 and 12 mg/kg, p.o.) was given for the last 4 weeks i.e. from week 15 to 18, to the Cd administered group. In the latter experiment, the Cd

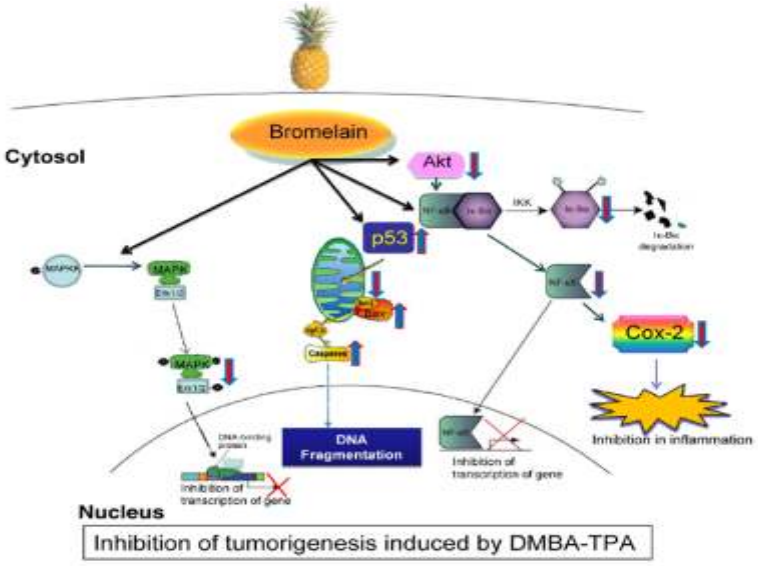


Microscopic evaluation of testicular tissue from Picroliv alone (12 mg/kg, p.o.), cadmium chloride (0.5 mg/kg, s.c.) and cadmium and Picroliv co-treated groups at 18 and 24 weeks. (H & E 125): (a) Picroliv (18 weeks). The seminiferous tubules were well developed with active spermatogenesis and prominent interstitial cellularity. (b) Cadmium (18 weeks). Interstitial tissues showed edema, hemorrhage and vacuolation. Many seminiferous tubules were edematous with intact germinal layer and undergoing degeneration along with loss of spermatogenesis. (c) Cadmium (18 weeks) and Picroliv. Interstitial edema was mild and restoration of spermatogenesis in most of the seminiferous tubules. (d) Picroliv (24 weeks). The seminiferous tubules and interstitial tissue were normal. (e) Cadmium (24 weeks). Edematous vasculitis and marked hemorrhage in stroma. Most of the seminiferous tubules showed significant loss of spermatogenesis. (f) Cadmium (24 weeks) and Picroliv. Hemorrhage and edema in stroma along with few degenerating seminiferous tubules. Other appeared vacuolated.

administration continued for 24 weeks and Picroliv was given from week 21 to 24. At 18 weeks, Cd caused alterations in oxidative stress indices like increased lipid peroxidation (MDA) and reduced levels of non protein sulphydryls (NPSH). They were found close to the control values by Picroliv treatment, suggesting its antioxidant potential. The increased levels of Zn and Ca were reduced by Picroliv, the Cd levels remained unaltered. The Cd induced testicular damage was also mitigated by Picroliv. The higher dose (12 mg/kg) being more effective than the lower dose. However, at 24 weeks of Cd exposure, the oxidative stress indicators in testis were more pronounced along with the morphological alterations. These parameters remained unaffected by Picroliv treatment. On comparative evaluation of the two studies, 18 weeks Cd exposure caused moderate testicular damage, which could be reversed significantly by Picroliv administration and correlated well with oxidative stress markers.Our results clearly demonstrate the ameliorative potential of Picroliv in Cd induced early testicular damage [N. Yadav, S. Khandelwal (2008) Food Chem Toxicol 46: 494-501].

7.7 Anti-tumorigen effect of bromelain through mitogen activated protein kinase pathway in mouse skin

Bromelain is a pharmacologically active compounds present in stems and immature fruits of pineapples (*Ananas cosmosus*) has been shown to have anti-edimatous, anti-inflammatory, anti-thrombotic and anti-metastatic properties. The, antitumorigenic activity of bromelain was recorded in 7-12, dimethylbenz(a)anthracene (DMBA) initiated and 12-O-tetradecanoylphorbol-13-acetate (TPA) promoted 2-stage mouse skin model. Results showed that bromelain application delayed the onset of tumorigenesis and reduced the cumulative number of tumors, tumor volume and the average number of tumor/mouse. To establish a cause and effect relationship, we targeted the proteins involved in the cell death



Possible mechanism of protection by bromelain in 2-stage mouse skin tumorigenesis model.

pathway. Bromelain supplementation resulted in upregulation of p53 and Bax, Caspase 3 and Caspase 9 with concomitant decrease in antiapoptotic protein Bcl-2 in mouse skin. Since persistent induction of cyclooxygenase-2 (Cox-2) is frequently implicated in tumorigenesis and is regulated by nuclear factor-kappa B (NF-κB), we also investigated the effect of bromelain on the Cox-2 and NF-κB expression. Results showed that bromelain application caused a significant inhibition of Cox-2 and inactivates NF-B by blocking phosphorylation and subsequent degradation of IκBα. In addition, bromelain supplementation attenuated DMBA-TPA induced phosphorylation of extracellular signal regulated protein kinase (ERK1/2), p38 mitogen-activated protein kinase (p38MAPK) and Akt. Taken together, we conclude that bromelain induces apoptosis related proteins along with inhibition of NF-κB driven-Cox-2 expression by blocking the MAP kinases and Akt/protein kinase B signaling in DMBA-TPA induced mouse skin tumors, which may account for its anti-tumorigenic effects [N. Kalra, K. Bhui, P. Roy, J. George, S. Prasad, Y. Shukla (2008) Toxicol Appl Pharmacol 226: 30-37].

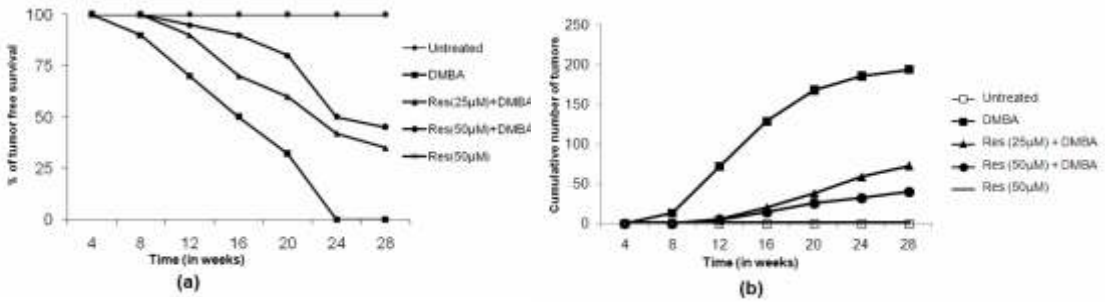
7.8 Chemopreventive Potential of Resveratrol in Mouse Skin Tumors through Regulation of Mitochondrial and PI3K/AKT Signaling Pathways

Cancer chemoprevention by phytochemicals may be one of the most feasible approaches for cancer control. We studied the chemopreventive potential of resveratrol, a phytoalexin found in seeds and skin of grapes, berries and peanuts in 7, 12-dimethyl benz(a)anthracene (DMBA) induced mouse skin tumorigenesis. Topical treatment of different doses of resveratrol (25µM/animal and 50µM/animal) was given to the Swiss albino mice, 1h prior to DMBA topically for 28 weeks. At the end of the study period, the skin tumors were dissected out and western blotting was carried out to examine the regulation of proteins involved in anti-tumorigenesis in response to resveratrol. Chemopreventive properties of resveratrol were reflected by delay in onset of tumorigenesis, reduced cumulative number of tumors, and reduction in tumor volume in a dose dependant manner. The induction of first tumor was observed on 52nd day in DMBA exposed animals but the onset of tumorigenesis was observed on 73rd and 79th day in resveratrol supplemented groups. About 35% of animals remained tumor free in low dose resveratrol supplemented group while 45% animals remained tumor free in high dose resveratrol supplemented group. The tumor volume was 98±10 mm^3 tumor volume/mouse in DMBA group, but it was only 485 mm^3 and 344 mm^3 in resveratrol supplemented groups. The cumulative number of tumors (CNT) in DMBA exposed animals was 194 at the time of the termination of experiment. The CNT was 73 and 40 in resveratrol supplemented groups, respectively. Results of the western blotting showed that resveratrol treatment increased the DMBA suppressed p53 and Bax while decreased the expression of Bcl-2 and Survivin. Further, resveratrol supplementation resulted in release of Cytochrome C, Caspases activation, increase in apoptotic protease-

activating factor-1 (Apaf-1) as mechanism of apoptosis induction. Resveratrol was also found to inhibit skin tumorigenesis through regulation of Phosphatidylinositol-3-kinase (PI3K) and AKT proteins which are implicated in cancer progression because it stimulates proliferation and suppresses apoptosis. The results showed that resveratrol regulates apoptosis and cell survival in mouse skin tumors as mechanism of chemoprevention hence deserve to be a chemopreventive agent [P. Roy, N. Kalra, S. Prasad, J. George, Y. Shukla (2008) Pharmaceutical Research DOI 10.1007/S 11095-008-9723-Z].

7.9 Induction of apoptosis by lupeol and mango extract in mouse prostate and LNCaP cells

Lupeol, a triterpene present in mango and other fruits, has shown to possess anti-cancer properties. Here, we explored the apoptogenic activity in mouse prostate by both lupeol and mango pulp extract (MPE). Testosterone was injected subcutaneously (5 mg/kg body



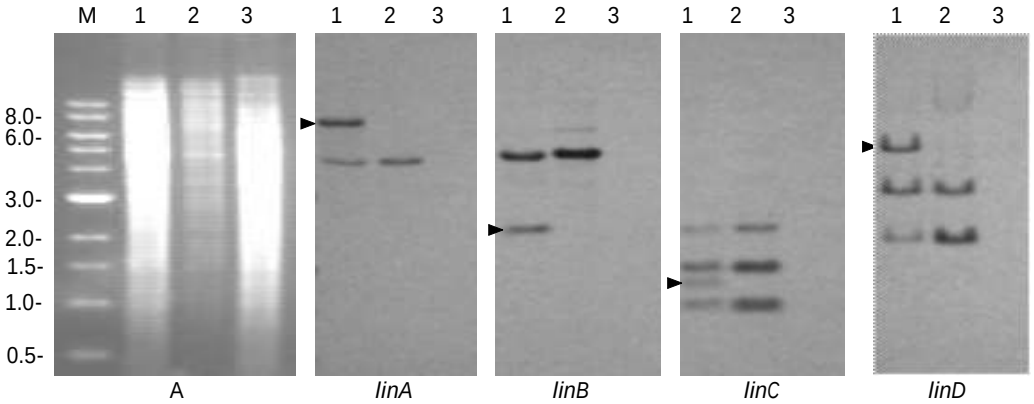
(a) Kaplan-Meir curve for the determination of tumor free survival by resveratrol treatment on DMBA induced tumorigenesis. The vertical axis shows the percentage of tumor free survival and the horizontal axis shows the weeks of treatment. (b) Effect of resveratrol on incidence of tumorigenesis in terms of cumulative number of tumors.

weight) for 15 consecutive days to male Swiss albino mice. Lupeol/MPE supplementation resulted in arrest of prostate enlargement in testosterone-treated animals and further resulted in an increase of apoptotic cells in hypo-diploid region. The induction of apoptosis in mouse prostate cells was preceded by the loss of mitochondrial transmembrane potential and DNA laddering pattern. In testosterone-induced mouse prostate, up regulation of anti-apoptotic B-cell non-Hodgkin lymphoma-2 and down regulation of pro-apoptotic Bcl-2-associated X protein and caspase-3 were noted. We further observed apoptogenic activities of lupeol in an in vitro model using human prostate cancer cells [lymph node carcinoma of the prostate (LNCaP)]. The apoptogenic response of lupeol-induced changes in LNCaP cells can be summarized as early increase of reactive oxygen species (ROS) followed by induction of mitochondrial pathway leading to cell death. The study confirms that lupeol/MPE is effective in combating testosterone-induced changes in mouse prostate as well as causing apoptosis by modulating cell-growth regulators [S. Prasad, N. Kalra, Y. Shukla (2008) N. Cancer 60; 120-130].

8. Industrial Waste Minimization & Bioremediation

8.1 Selective loss of lin genes from hexachlorocyclohexane-degrading *Pseudomonas aeruginosa* ITRC-5 under different growth conditions

Two formulations of the chlorinated insecticide hexachlorocyclohexane (HCH), technical-HCH that predominantly consists of -α(60-70%), β-(5-13%), γ- (10-18%) and δ-isomers (6-10%), and another lindane that consists of >99% α-HCH, have been used extensively in the past. Numerous HCH-contaminated sites are present throughout the world, and pose serious risk to human health. For their bioremediation, we isolated a bacterium *Pseudomonas aeruginosa* ITRC-5 that mediates the degradation of HCH-

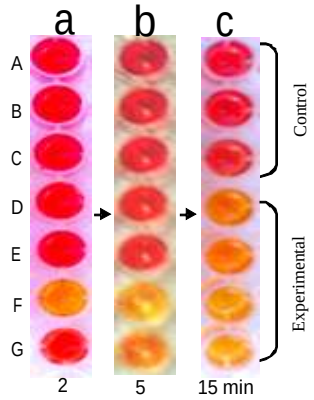


Southern blot analysis, showing selective loss of genes *linA – linD* under different growth conditions i.e. t-HCH, ?-HCH and LB-grown cells (lanes 1-3, respectively). Visualization by ethidium bromide staining is shown in Panel A. Lane M is 1-10 kb DNA size ladder. DNA fragments that were lost in '?-HCH-grown cells' are indicated by arrowheads. All the *lin* genes were lost in 'LB-grown cells'.

isomers. Two or more copies of the genes *linA, linB, linC, linD* and possibly *linE,* whose products sequentially metabolize a-HCH, are present in this bacterium. At least one or all the copies of these are lost from ITRC-5 during its growth on α-HCH or Luria-Bertani medium, respectively. The loss of *lin* genes is accompanied with the loss/ rearrangement of insertion sequence *IS6100* genes. Concomitant to this loss, the degradation of HCH-isomers by α-HCH grown cells' is slower when compared with 'technical-HCH grown cells', and is completely lost by 'LB-grown cells'. Thus the bacterium, when grown with t-HCH, γ-HCH or LB-medium, would have different efficacy towards the bioremediations of contaminated soils. The selective loss of *lin* genes during different growth conditions has not been reported before, and is expected to help in understanding the dynamism of degradative genes in soil habitats [A. K. Singh, P. Chaudhary, A. S. Macwan, U. N. Dwivedi, A. Kumar (2007) Appl Microbiol Biotechnol 76: 895-901].

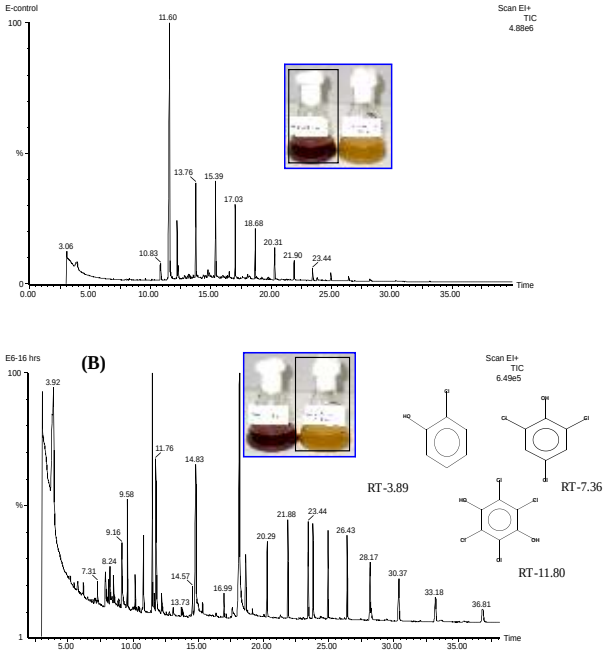
8.2 Isolation of hexachlorocyclohexane-degrading *Sphingomonas sp.* by dehalogenase assay and characterization of genes involved in γ-HCH degradation

The pollution by chlorinated pesticides is widespread in the environment and is creating health problems. Utilization of microorganisms to clean up the residues from a polluted environment is a potential solution. Isolation of xenobiotic-degrading bacterial populations in contaminated environments using traditional microbiological methods such as selective enrichment, can take long time. On the other hand, a colorimetric assay that detects dehalogenase activity is sensitive, rapid, inexpensive and highly useful for routine screening of large number of samples simultaneously. In the present study, we have used the colorimetric assay and identified a *Sphingomonas sp.* strain NM05 that degrades all the four isomers of HCH. Metabolites formed by the degradation of HCH-isomers were identified and genes involved in the process were studied and characterized. Dechlorinase activity assays were used to screen bacteria from contaminated soil samples for HCH-degrading activity. A bacterium able to grow on α-, β-,γ-, and δ-HCH as the sole carbon and energy source was identified. This bacterium was a novel species belonging to the genus Sphingomonas and harbours *linABCDE* genes similar to those found in other HCH degraders. γ-Pentachlorocyclohexene, 1,2,4-trichlorobenzene and chlorohydroquinone were identified as metabolites during the degradation of γ-HCH. The study demonstrates that HCH-degrading bacteria can be identified from large environmental sample-based dehalogenase enzyme assay. Significance and impact of the study is that the chlorinated pesticide HCH is a persistent and toxic environmental pollutant which needs to be remediated and therefore, the isolation of diverse bacterial species capable of degrading all the isomers of HCH will help in large-scale bioremediation in various parts of the world [N. Manickam, M.K. Reddy, H. S. Saini, R. Shanker (2008) J Appl Microbiol 104: 952-960].



Colorimetric assay of HCH -isomers dechlorination using cell free extract of strain NM05. The incubation was for (a) 2, (b) 5 and (c) 15 minutes intervals. Wells A, B and C represent controls, where A: sonication buffer, B: cell free extract without HCH, C: heat -denatured cell free extract with HCH. Wells D-G represent complete reaction mixture with a final concentration of 25 µg/ml of each a-, ß-, γ-, and δ-HCH separately.

8.3 Reduction of pollutants in pulp paper mill effluent treated by PCP-degrading bacterial strains

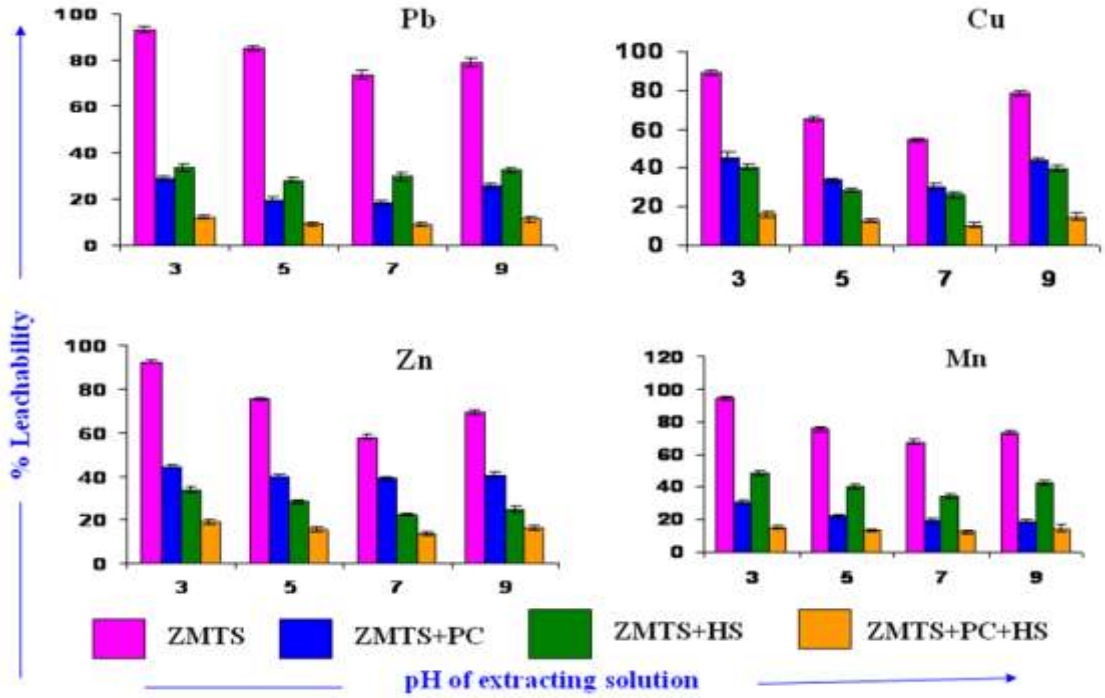


Chlorophenol compounds identified in ethyl acetate extract from control (A) and bacterial treated (ITRC S-6) (B) pulp paper mill effluent through GC-MS analysis.

Three aerobic bacterial strains namely ITRC S6, ITRC S7 & ITRC S9 were isolated from pulp paper mill waste. The mixed culture was found to degrade pentachlorophenol (300 mg L^{-1}) upto 93.08% in mineral salt medium (MSM) with 1% glucose (w/v) at 30 ± 1^0C, pH 7.0 ± 2 at 120 rpm in 168 h incubation period. These strains were identified as *Bacillus cereus* (ITRC S6, DQ 002384), *Serratia marcescens* (ITRC S7, AY927692) and *Serratia marcescens* (ITRC S9, DQ 002385). Further, the application of two PCP-degrading bacterial strains were used for the treatment of pulp and paper mill effluent at conditions; 1.0% glucose and 0.5% peptone at 30±1°C at 120 rpm for 168 h of incubation. These two bacterial strains effectively reduced colour (45-52%), lignin (30-42%), BOD (40-70%), COD (50-60%), total phenol (32-40%) and PCP (85-90%) within 168 h of incubation. However, the highest reduction in colour (62%), lignin (54%), BOD (70%), COD (90%), total phenol (90%) and PCP (100%) was recorded by mixed culture treatment. The bacterial mechanism for the degradation of pulp and paper mill effluent may be explained by an increase in the cells biomass using added co-substrates resulting in liberation of significant amount of chloride due to bacterial dechlorination of chlorolignins and chlorophenols leading to reduction in colour, lignin and toxicity in the effluent. Furthermore, GC-MS analysis of ethyl acetate-extractable compounds from treated pulp paper mill effluent confirms that the bacterium has capability for the degradation of lignin and pentachlorophenol, as many aromatic compounds such as 2-chlorophenol, 2, 4, 6-trichlorophenol and tetrachloro-hydroquinone, 6-chlorohy-droxyquinol and tetrachlorohy droquinone detected were not present in the untreated effluent (Fig A-B). Hence, these bacteria can be used for detoxification of pulp paper mill waste [S. Singh, R. Chandra, D. K. Patel, V. Rai (2007) World J Microbiol Biotechnol 23: 1747-1754; S. Singh, R. Chandra, D. K. Patel, R. M. M. Krishna, V. Rai (2008) Biores Technol 99: 5703-5709; R. Chandra, A. Raj, S. Yadav, D. K. Patel (2008) Environ Monitor Assess DOI 10.1007/s10661-008-0413-4].

8.4 Sorption efficacy of phosphatic clay and humus rich soil in leachability of heavy metals from Zinc mine tailings

Contamination of soil by heavy metals mainly due to acid mine drainage, tailings embankments, mining rock dumps and metallurgical waste piles pose a serious threat to the environment. These heavy metals even in low concentrations are known to have potential impact on environmental quality and human health via ground water and surface water. The metal mobility largely depends upon sorption and leachability of heavy metals with different soil constituents. In view of this, sorption efficacy of phosphatic clay and humus rich soil alone and on combination was tested towards heavy metals present in Zinc mine tailing (Zawar Zinc Mine) Udaipur (India). Characterization of Zinc mine-tailing sample indicated the presence of Pb, Cu, Zn and Mn in the concentration of 637 µg g^{-1}, 186 µg g^{-1}, 720 µg g^{-1} and 577 µg g^{-1} respectively. For sorption efficacy, the Zinc mine tailing soil were properly



Percent Leachability of Pb, Cu, Zn and Mn in different soil system as a function of pH. ZMTS=Zinc mine tailings; ZMTS+PC=Zinc mine tailings +Phosphatic day; ZMTS+HS = Zinc mine tailings + Humus soil; ZMTS+PC+HS = Zinc mine tailings + Phosphatic day + Humus soil

amended with phosphatic clay and humus rich soil separately and in combination and leachability study was performed by batch experiment at different pH range from (3-9). The data showed that the percent leachability of heavy metal in non-amended soil was 75-90%. After amendment with phosphatic clay percent leachability of heavy metals became 35-45%. Further, the addition of humus soil to phosphatic clay decreased the percent

leachability up to 5-15% at all tested pH. The most common selectivity sequence calculated on the basis of distribution coefficient (K_d) from the batch experiment was Pb>Cu>Zn>Mn. Further, Langmuir isotherms applied for the sorption studies indicated that phosphatic clay in the presence of humus soil had high affinity for Pb followed by Cu, Zn and Mn, with sorption capacities 139.94, 97.02, 83.32 and 67.58 µg g^{-1} respectively and could be used as a cost effective immobilizing agents for better immobilization of heavy metals from the soil contaminated with heavy metals [P. K. Chaturvedi, C. S. Seth, V. Misra (2007) J. Hazardous Materials 147: 698-705].

9. Environmental Chemicals Induced Toxic Manifestations

9.1 Effect of Maneb and Paraquat exposure on oxidative stress in rat polymorphs

Maneb (MB) and Paraquat (PQ)-induced oxidative stress in polymorphonuclear leukocytes (PMNs) of exposed rats was investigated. Animals were treated i.p with or without MB (30 mg/kg) and/or PQ (10 mg/kg) in an exposure time dependent manner. In some sets of experiments, the animals were pre-treated with NOS inhibitors- N^G-nitro-L-arginine methyl ester (L-NAME) and aminoguanidine (AG), 20mg/kg i.p along with respective controls. A statistically significant increase in myeloperoxidase (MPO), superoxide dismutase (SOD), nitric oxide, iNOS expression and lipid peroxidation (LPO) was observed in PMNs of MB- and/or PQ-treated animals while catalase and glutathione S-transferase (GST) activities were attenuated. L-NAME and AG significantly reduced the augmented nitrite content, iNOS expression and MPO activity to control level in MB and PQ exposed animals. Although the augmented LPO was also reduced significantly in L-NAME and AG treated rat PMNs, the level was still higher as compared with controls. The results obtained suggest that MB and PQ both induced oxidative stress in rat PMNs but in combination had greater potential for oxidative stress generation. MB and/or PQ augmented NO production through iNOS-mediated pathway, which in turn increased MPO activity and lipid peroxidation thereby leading to oxidative stress [I. Ahmad, A. Kumar, S. Shukla, H. P. Pandey, C. Singh (2008) Free Rad Res; *in press*].

9.2 Oxidative stress, histopathology and expression of metallothionein mRNA in mercury exposed rats: Effect of pre or post Treatment of selenium/ vitamin E/ curcumin

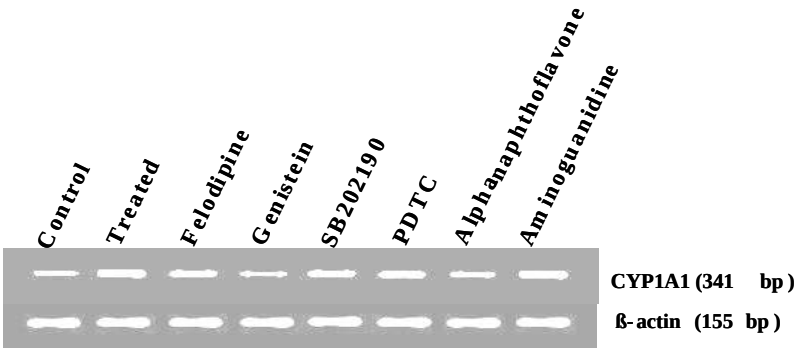
Toxicological investigations were conducted to examine the oxidative stress, histopathological alterations and effect on metallothionein (MT) mRNA expression caused by mercury exposure in rats (12 μmole Hg /kg b.w. as mercuric chloride, single intraperitoneal injection). We observed mercury accumulation in liver, kidney and blood along with significant enhancement in lipid peroxidation due to mercury. Significant alterations were observed in superoxide dismutase, glutathione peroxidase and catalase activities in the tissues. Depletion in glutathione levels in liver and kidney and alterations in serum alkaline phosphatase, lactate dehydrogenase activities and creatinine and blood urea nitrogen levels were indicative of the fact that there was damage in liver and kidney due to mercury exposure. These findings have further been supported by histopathological investigations. Metallothioneins (MTs) are a nonenzyme protein of low molecular mass (6-7 kDa), act as biological chelators of heavy metals. An induction in the expression of MT-I and MT-II mRNA in liver and kidney tissues was observed after mercury exposure.

Antioxidants are present in many foods and play a role in amelioration of oxidative stress. We therefore, endeavoured to examine the role of pre or post (prophylactic /therapeutic) treatment of antioxidants viz. selenium (6 μmole/kg b.w., single intraperitoneal injection), vitamin E (24 μmole/kg b.w., single intraperitoneal injection) and curcumin (80 mg/kg b.w., three oral doses) in mercury intoxication in terms of above mentioned parameters. Our results suggest that selenium and curcumin could be good dietary supplements to prevent /minimize health implications due to any unforeseen mercury exposure, while vitamin E could be used as a therapeutic agent [R. Agarwal, J. R. Behari (2007) Bull Environ Contam Toxicol 79: 306-310].

9.3 CYP1A1-mediated iNOS expression in benzo(a)pyrene-treated rat polymorphonuclear leukocytes: role of secondary mediators

In this study, the involvement of secondary signaling molecules in CYP1A1-mediated augmentation of iNOS expression in benzo(a)pyrene-treated rat PMNs was investigated. PMNs were isolated from the peripheral blood of controls and benzo(a)pyrene-treated rats. The expression and/or activity of CYP1A1, iNOS, tumor necrosis factor-alpha (TNF-α), interleukin-1 beta (IL-1β), and intracellular calcium ($[Ca^{2+}]i$) concentrations were measured in control and benzo(a)pyrene-treated rat PMNs with and without alpha-naphthoflavone, aminoguanidine, genistein, pyrrolidine dithiocarbamate (PDTC), felodipine, or SB202190 pre-treatment. A significant elevation in CYP1A1 and $[Ca^{2+}]i$ was observed in benzo(a)pyrene-treated rat PMNs, which was significantly restored by alpha-

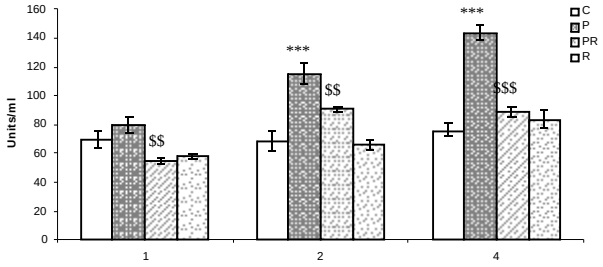
naphthoflavone or genistein. Neither PDTC, SB202190, nor aminoguanidine altered the benzo(a)pyrene-mediated increase in $[Ca^{2+}]i$. Although felodipine reduced the benzo(a)pyrene-mediated increase in $[Ca^{2+}]i$, no significant change was observed in CYP1A1 expression and activity. Benzo(a)pyrene-augmented iNOS expression and activity in PMNs was significantly reversed by felodipine, genistein, or PDTC. Benzo(a)pyrene also induced TNF-α and IL-1β production in PMNs, which was significantly reversed by genistein. The results demonstrated the involvement of $[Ca^{2+}]i$, tyrosine kinase, inflammatory cytokines, and NF-kB in CYP1A1-mediated iNOS expression in benzo(a)pyrene-treated rat PMNs [A. Kumar, G. Upadhyay, D. R. Modi, M.P. Singh (2007) Life Sci 81:1575-1584].



Effect of felodipine, genistein, SB202190, PDTC, alpha-naphthoflavone and minoguanidine on CYP1A1 mRNA expression in rat PMNs. The mRNA expression of CYP1A1 and β-actin are shown in control and benzo(a)pyrene-treated rat PMNs in the presence or absence of felodipine, genistein, SB202190, PDTC, alpha-naphthoflavone and aminoguanidine.

9.4 Resveratrol-mediated modulation in pyrogallol-induced hepatotoxicity

The study was performed to assess the effect of resveratrol against pyrogallol-induced changes in hepatic damage markers, xenobiotic metabolizing enzymes and oxidative stress. Swiss albino mice were treated intraperitoneally, daily with pyrogallol (40 mg/kg), for one to four weeks, along with respective controls. In some set of experiments, animals were pre-treated with resveratrol (10 mg/kg), 2 h prior to pyrogallol treatment, along with respective controls. Alanine aminotransaminase, aspartate aminotransaminase and bilirubin were measured in blood plasma and mRNA expression of cytochrome P-450 (CYP) 1A1, CYP1A2, CYP2E1, glutathione-S-transferase (GST)-ya and GST-yc, catalytic activity of CYP1A1, CYP1A2, CYP2E1, GST, glutathione reductase and glutathione peroxidase, lipid peroxidation and reduced glutathione (GSH) level were measured in liver. Resveratrol reduced pyrogallol-

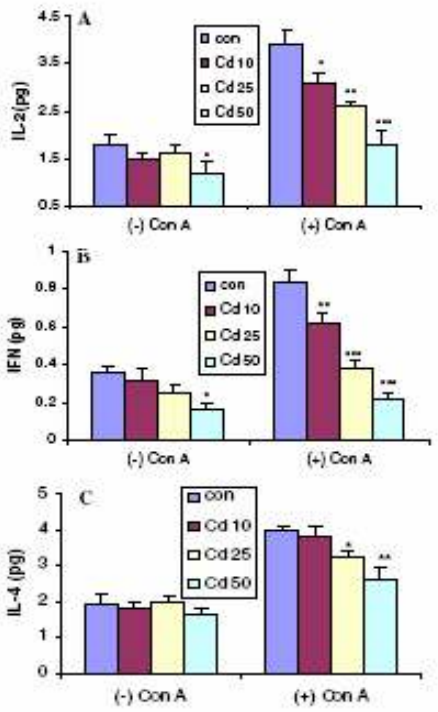


Aspartate aminotransaminase content in blood plasma of control and treated mice. The values are expressed as means ± S.E.M. [pyrogallol treated (P) versus (vs.) vehicle control (C) ***(P<0.001)}, pyrogallol treated (P) vs. pyrogallol + resveratrol (PR) {$$(P<0.01) and $$$(P<0.001)}]. The tendencies of change in endpoints are expressed between the groups within the same time point.

mediated increase in alanine aminotransaminase, aspartate aminotransaminase, bilirubin, lipid peroxidation and mRNA expression and catalytic activity of CYP2E1 and CYP1A2. Pyrogallol-mediated decrease in GST-ya and GST-yc expressions, GST, glutathione peroxidase and glutathione reductase activities and GSH content was significantly attenuated in resveratrol co-treated animals. CYP1A1 expression and catalytic activity was not altered significantly in any treated groups. The results demonstrate that resveratrol modulates pyrogallol-induced changes in hepatic toxicity markers, xenobiotic metabolizing enzymes and oxidative stress [G. Upadhyay, A. K. Singh, A. Kumar, O. Prakash, M. P. Singh (2008) Eur J Pharmacol 596: 146-152].

9.5 Impact of Cadmium in T lymphocyte subsets and cytokine expression: differential regulation by oxidative stress and apoptosis

To understand the involvement of reactive oxygen species (ROS), intracellular glutathione (GSH) and apoptosis in modulation of T-cell repertoire, we studied the effect of Cd (10,25 and 50 µM) on primary T lymphocytes of BALB/c mice at different time intervals (6,12 and 18 h). We observed a dose and time dependent decline in CD4+/CD8+ ratio (a bio-indicator of immunotoxicity) as a result of significant suppression of CD4+ subsets (helper T-cells) and enhancement in CD8+ cells (cytotoxic T-cells). At the same time, the CD4+ CD8+ (DP) cell population was lowered while the CD4- CD8- (DN) cells were increased. The oxidative stress and apoptotic data revealed almost similar ROS generation in both CD4+ and CD8+ cells, but relatively more marked GSH depletion and apoptosis in CD4+ than in CD8+ population. On further analysis of CD4+ T-subsets, cytokine release (IL-2 and IFNγ) by Th1 cells and IL-4 by Th2 cells were shown to be significantly suppressed in a dose responsive manner. The highest inhibition was observed in IFNγ, then IL-2 followed by IL-4. In conclusion, our data demonstrates that T-cell apoptosis by Cd, more in CD4+ than in CD8+ cells appear related to higher depletion of intracellular glutathione. Th1 cells of CD4+ sub-population are more responsive to Cd than Th2, leading to higher suppression of IL-2 and IFN than IL-4 and hence, the study unravels to some extent, the underlying events involved in Cd immunotoxicity [N. Pathak, S. Khandelwal (2008) Biometals 21: 179-187].



Effect of Cd on cytokine levels. Freshly isolated thymocytes (1.0 × 104) were treated with Cd (10–50µM), and Con A (2.5 mg/ml) for 72 h at 37°C. The cytokines (IL-2, IL-4 and IFNγ) were measured by ELISA kits. Each bar represents mean ± SD (n = 3). ***P < 0.001, **P < 0.01, *P < 0.05 as compared to control, using one-way ANOVA.

10. Environmental Monitoring & Health Surveys

10.1 Source apportionment of PAHs in urban atmosphere

This study reports source apportionment of polycyclic aromatic hydrocarbons (PAHs) in particulate depositions on vegetation foliages near highway in the urban environment of Lucknow city (India) using the principal components analysis/absolute principal components scores (PCA/APCS) receptor modeling approach. The multivariate method enables identification of major PAHs sources along with their quantitative contributions with respect to individual PAH. The PCA identified three major sources of PAHs viz. combustion, vehicular emissions, and diesel based activities. The PCA/APCS receptor modeling approach revealed that the combustion sources (natural gas, wood, coal/coke, biomass) contributed 19–97% of various PAHs, vehicular emissions 0–70%, diesel based sources 0–81% and other miscellaneous sources 0–20% of different PAHs. The contributions of major pyrolytic and petrogenic sources to the total PAHs were 56 and 42%, respectively. Further, the combustion related sources contribute major fraction of the carcinogenic PAHs in the study area. High correlation coefficient (R2>0.75 for most PAHs) between the measured and predicted concentrations of PAHs suggests for the applicability of the PCA/APCS receptor modeling approach for estimation of source contribution to the PAHs in particulates [K.P. Singh, A. Malik, R. Kumar (2008) Environ Monit Assess 136:183-196].

10.2 Assessment of environmental quality of Lucknow city, during pre-monsoon (May-June 2007)

Survey of air pollution in the Lucknow city was conducted during May- June representing pre-monsoon period, to create awareness in masses about the increasing trend of urban pollution and to help the administrative agency to take remedial measures for the improvement of environmental conditions.

The survey 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 one industrial area. Results revealed higher concentration of pollutants near traffic junctions 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. A significant reduction in the concentration of the SPM and RSPM was observed due to removal of diesel operated tempos from the trunk road and introduction of CNG tempos in the city.

10.3 Monitoring and evaluation of environmental parameters

The monitoring of parameters for different environmental components viz; air (respirable suspended particulate matter, suspended particulate matter, sulphur dioxide, oxides of nitrogen), meteorology (wind speed, wind direction, temperature, humidity, rainfall), stack emission (particulate matter, sulphur dioxide, oxides of nitrogen), water and effluent analysis (physico-chemical, metal and bacteriological quality) and soil quality (mechanical, physico-chemical and metals). Besides the above common parameters, some other parameters like hydrocarbon, carbon monoxide, PAH and mercury and noise level were also monitored.

The above common parameters were monitored for the following projects

i. Monitoring of Environmental Parameters of M/s. GAIL India Ltd ., Pata.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.
ii. Evaluation of Ambient Air Quality, Stack Emissions, Water and Wastewater of M/s. Anpara Thermal Power Station Anpara, Distt. Sonebhadra, U.P.
iii. 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.
iv. Environmental Monitoring for Stack Emission, Ambient Air Quality, Effluent water analysis and sludge analysis of M/s Paricha Thermal Power Plant, Paricha, U.P.
v. Testing and Monitoring of Stack Emission, Ambient Air Quality Monitoring and Water Effluent Testing of Panki Thermal Power Plant, Panki, Kanpur, U.P.
vi. Monitoring of Process/ Stack Emission, Ambient Air Quality, Water/ Effluent, Soil and Sludge Quality of ITI Ltd., Mankapur.
vii. Monitoring of Environmental parameters of Renusagar Power Division of HINDALCO Industries, Renusagar.
viii. Monitoring of Environmental parameters of Kanoria Chemical & Industries Ltd., Renukoot.

10.4 Monitoring of pesticide residues at national level

IITR is participating in All India Network projects on Monitoring of Pesticide Residues in food commodities at national level. 225 samples of vegetables (okra, brinjal, tomato, cauliflower and cabbage), 45 samples of fruits (apples, grapes, organge, pomegranates and papaya), 36 samples of wheat and rice, 9 samples each of milk and butter and 3 samples of ground water were analyzed for the presence of 14 organochlorines (Aldrin, α-HCH, β-HCH, γ-HCH, δ-HCH, butachlor, Chlordane, pp'-DDE, pp'DDD, ppDDT, dicofol, endosulfan I, Endosulfan II, heptachlor), 7 pyrethroids (α-cypermethrin, β-cypermethrin, deltamethrin, fenvalerate, lamdacyhalothrin, fenpropathrin, β-cyfluthrin)

and 13 organophosphate (acephate, phorate, monocrotophos, phosphamidon, dimethoate, malathion, chloropyrifos methyl, chloropyrifos, fention, quinalphos, profenofos, chlorofevinfos and ethion) pesticide residues. It was observed that most of the samples have shown the presence of these pesticide residues but residues were below to their MRL values. 25 vegetables, 6 fruits, 1 milk and 2 cereal samples have shown presence of few organochlorine pesticide residues above their MRL values. None of the butter and water samples were found contaminated with pesticide residues.

10.5 Health studies of subjects living around Special Economic Zone in National Capital Region

A pilot survey was conducted at adjoining areas of Noida Special Economic Zone (NSEZ) for identifying the locations, information on the demographic profile in order to calculate the sampling frame and sample size. A detailed clinical examination including nervous system, cardio-vascular system, respiratory system, gastro-intestinal system, reproductive system, genito-urinary system, musculo-skeletal system was conducted on 610 residents living near NSEZ area viz., Bangal, Salarpur, Bhaktiyarpur, Hazipur, Safarabad, and Basai. Sample of drinking water from tube well and hand pump was collected from all the identified residential areas near NSEZ for estimation of physico-chemical properties, bacterial count etc. Ambient air monitoring for PM^{10}, $PM^{2.5}$, PM^{1}, TSP, VOC and noise level were analysed from the identified residential locations near NSEZ. Maximum levels of PM^{10}, $PM^{2.5}$ exceed the NAAQS permissible limit at Bangal, Bhaktiyarpur and Hazipur. Maximum TSP level observed at Bangal, Hazipur and Bhaktiyarpur were higher than NAAQS permissible limit. Noise level at Bangal, Bhaktiyarpur and Hazipur were higher than the prescribed limit as per CPCB norms for the residential areas. A detailed respiratory health survey was conducted on 590 residents from Bangal, Salarpur, Bhaktiyarpur, Hazipur, Safarabad and Basai (residential areas located on the west and eastern sides of NSEZ). Clinical examination for respiratory morbidity, body composition monitoring, lung function test was included in the respiratory health survey.

10.6 Health risk assessment and environmental monitoring among pesticide sprayers in mango plantations of U.P.

Health survey was conducted on 129 male pesticide sprayers in Malihabad mango plantation, Lucknow during pre-spraying season. The physical characteristics viz., age, height and weight were 37.2 ± 16.2 years,162.7± 6 cm and 51.8 ± 8.5 kg respectively. Morbidity profile shows symptom wise abnormalities in nervous, respiratory, ocular, musculo-skeletal, cardio-vascular and reproductive system. Hypertension, haematological abnormalities, airway obstruction and nerve conduction abnormalities were observed in sprayers. Exposure to pesticide during spraying operation, storage of pesticide at home,

avoiding hygienic conditions like bath after spray etc. add to the health problems observed in the study. Blood Acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity and estimation of organochlorine pesticide residue levels in the blood of pesticide sprayers were analyzed.

10.7 Body fat examination camp organized on National Science Day, 2008

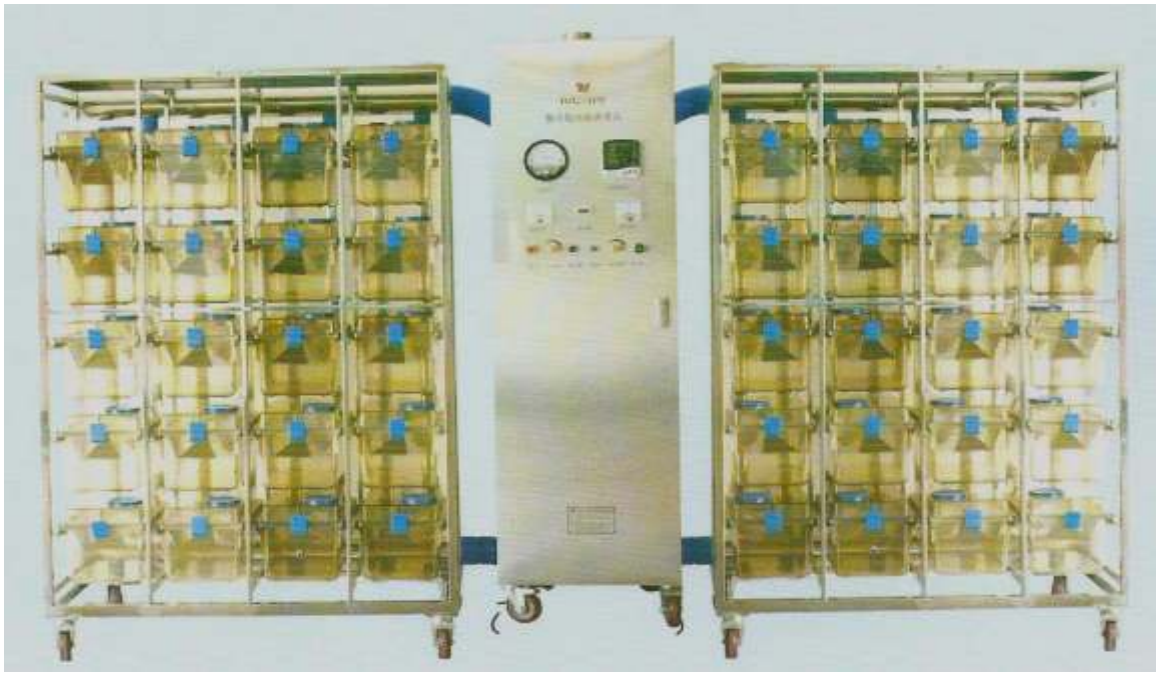
Body fat examination using bio electric impedance analysis was demonstrated and performed for the public and school children who visited the stall of Epidemiology Division, IITR, Lucknow during National Science day exhibition held at IITR lawns, Lucknow. Body fat examination included determination of body mass index as per WHO guidelines (1995). Body fat per cent and Visceral fat level (also known as abdominal obesity) was determined using Japan Society for study of obesity (2002) recommendations. Nearly 150 persons visited the stall. These include adults and school children. One hundred and thirteen opted for body fat examination. More than fourty per cent had body mass index within the normal range. Body fat per cent analysis of these subjects revealed that 41 subjects (36 %) had normal body fat per cent. Visceral fat analysis was done for 54 adult subjects, 32 (59 %) of these had normal amount of visceral fat. While there is an existing interest and awareness regarding common problems associated with excess body fat such as its role in cardiovascular diseases, diabetes mellitus, arthritis etc., the importance of excess fat vis a vis accumulation of toxicants like pesticides in adipose tissue and its likely effect on health are largely not appreciated. These include disorders of nervous system, hormonal problems, cancers etc. Awareness about this was created using charts and visual aids. Visitors were advised to take measures to improve their physical status based on the body fat examination.

New Facilities

Individually Ventilated Cage System

Institute has a state of art animal facility for animal breeding and experimentation. This facility was recently upgraded by equipping it with "individually ventilated cage system" to improve safety for animals and humans in research environment. Here, animals are maintained under positive pressure to avoid any contamination and each unit cage of the system act as an isolator, therefore inbred animals and susceptible hairless mouse or nude mouse can also be reared through IVC system. Various regulatory studies where observation of each individual animal is required this IVC unit is ideal. Other studies like evaluation of biopesticides (Microbials) may also be carried out with the help of this instrument.

IV cage with animals



Individually ventilated cage system

Zetasizer nano ZS

Zetasizer nanoZS-from Malvem Instruments, UK was installed at IITR for size and zeta potential measurement of nanoparticles to be evaluated for their safety and toxicity. The instrument provides the ability to measure size and zeta potential of particles in a liquid medium. The instrument measures the particle size by dynamic light scattering in the range of 0.6 nm to 0.6 µm. The zeta potential is measured using a laser in the range of 5 nm to 10 µm.

Zetasizer nano ZS – Malvern Instruments

Multimode Plate Reader

IITR acquired a 'Multi mode plate reader' with monochromator based absorbance and filter base fluorescence gadget, including luminiscence. It has a reading time of 15 sec. for 96 well plate, 30 sec for 384 well plate and 60 sec for 1536 well plates. The limit of detection is <1 fmol /well fluorescence top and bottom. It can accommodate 8 filters for excitation and 8 for emission. There are 2 injector built in the system for luminiscence mode and has a detection limit of 0.5 fmol / well ATP.

Multimode plate reader (BMG labtech, Germany)

Capabilities and Expertise

- Toxicity studies using various test model organisms as per the national and international standard guidelines.
- Analysis of polyaromatic hydrocarbons, pesticides, dyes and various chemical metabolites from biological samples and various environmental matrices like air, water sediments and soils, by sophisticated equipments.
- Evaluation of genotoxic, carcinogenic and mutagenic potential of xenobiotics using both *in vivo* and *in vitro* test systems. *In vivo* genotoxicity assessment using alkaline comet assay.
- Small interfering RNA (siRNA) and RNA interference (RNAi) based studies for cell signaling pathway to understand the therapeutic benefit of drugs
- Microarray profiling of differential expression of mouse genes after exposure to various toxicants.
- Microarray technology for the detection of genes involved in biodegradation of toxic chemicals and exploration of bacterial diversity from hazardous eco-systems.
- Real-time polymerase chain reaction (RT-PCR) to detect microbial pathogens and genetically modified crops.
- Microplate-based, semi-automated assay for evaluating antioxidant potential of medicinal plant ingredients. Random amplified polymorphic DNA (RAPD) profiling of medicinal plants collected from different eco-zones of India.
- Molecular studies involving DNA methylation to understand the onset of inflammatory diseases.

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, Poisindex, IPCSINTOX, 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. IITR library has a rich collection of literature encompassing state-of-the art information in the area of industrial and environmental toxicology. Presently, the Library is enriched with 31,500 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 132 books, 346 bound periodicals, 103 IITR Research Papers and 77 Annual Reports of different Institutions. Library has subscribed to 108 periodicals (50 Foreign and 58 Indian), 4 online journals and 2 international database on CD ROM. Few books in Hindi language were also added to promote the Rajbhasha. The library updated its software LIBSYS-3 to LIBSYS-4 Rel 5.7.2 (web enabled interface). Full text access of 14 biomedical publishers is available to all scientists on their desktop computer under CSIR E-journals consortium. Full text access of Bureau of Indian Standards, WEB of science and Indianjournals.com was also made available to IITR scientist.

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 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 IITR since the past 4 plan periods. The work carried out during the year 2007-08 is given below:

- Database on Toxic Chemicals Information related to 50 chemicals used as pesticides 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.
- Database on Treatment and Antidotes for Chemical Poisoning has been developed. The information pertain treatment of chemical poisoning and its antidotes. Information includes chemical names, synonyms, general chemical and physical properties, uses, symptoms of exposure, antidotes and treatment in case of poisoning along with 3D structure viewer for 163 chemicals used in common chemical laboratory.

Publications

a) Abstracts of Current Literature in Toxicology, Vol. 20, No.1-2 (Jan-June) 2007 with 207 abstracts and Vol. 20 No. 3-4 (July-Dec) 2007, 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. 4, 5 and 6 and Vol. 15, No. 1 have been published this year on thematic areas: Nanotoxicology; Indoor air pollution; Electronic waste; Contamination in vegetables, respectively.

c) An annotated bibliography of Indian Literature on Lead (1987 - 2007).
d) Enviro Files: a compilation of newspaper clippings.

- Environmental Information: A total of 76 queries were processed and relevant information provided to users. Queries were mostly related to chemicals and the environment particularly human health, industry, agriculture, chemistry and biochemical processes, and pollution & wastes.

Website Management

The website is being maintained and following activities were undertaken:

1. Website configured on NIC server at http://www.itrcenvis.nic.in
2. Mirror image of the ENVIS website is maintained at http: // www. envisiitr. org.in
3. Three dimensional structure file (sdf file) along with dynamic structure viewing applet for 220 pesticides have been uploaded.
4. Specialized web databases along with user friendly search engine designed and uploaded on:
   a. Treatment and Antidotes for chemical poisoning
   b. Traditional antidotes against snake and scorpion poisoning
   c. Bibliography of Indian literature on arsenic (2000-2007)
   d. Toxicology Map of India – organo chlorine pesticides
5. Online information made available: Newsletter upto Feb. 2008; Archives since 2000; 15 to 20 abstracts of current literature in toxicology and environment added each month available since June 2000; "Environmental News" added daily from newspapers; scientific magazines and journals. All ENVIS publications are available on the website.

Computer Centre

Computer Centre provides central computing facility to the staff of the Institute engaged in R&D and S&T activities. This facility includes development and maintenance of application softwares, web sites, and databases. The Computer Centre also provides internet facilities and maintains a campus wide Local Area Network consisting of more than 225 nodes. It also manages, monitor and coordinate 2 Mbps 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 further been strengthened under the CSIR project on "Building a Scientific Knowledge Grid, ICT Infrastructure and Services for CSIR Laboratories".

Animal Facility

To maintain credibility and compete in the international research scenario of the toxicological testing, IITR has 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.

IITR animal facility provide animals to various institutions for their research work and experimentations.

Central Pathology Laboratory

The laboratory is a central facility to undertake pathological investigations for In-house R & D projects as well for sponsored regulatory studies. The laboratory is well equipped with modern equipments like automatic tissue processor, tissue embedding system, automatic blood biochemical analyzer and hematology analyzer. The laboratory has NABL accreditation for biological testing at IITR.

Calibration facility with 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 IITR 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 Spectrophotometer (AAS), High Performance Liquid Chromatography (HPLC)., Gas Liquid Chromatography (GLC),-Gas Chromatograph-Mass Spectrometer (GC-MS) and Scintillation counter. 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 SPME technique has also been utilized for the analysis of volatile compouds 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.

Human Resource Development

International Conference on Nanomaterial Toxicology (ICONTOX 2008)

The International Conference on Nanomaterial Toxicology was jointly organized by Indian Institute of Toxicology Research, Lucknow and Indian Nanoscience Society from February 5-7, 2008. More than 110 participants from 11 countries namely U.S.A., Canada, U.K., Italy, Germany, France, Switzerland, Belgium, Brazil, Finland and India attended the conference. Researchers delivered 54 invited lectures in six scientific sessions and 29 posters were presented during the conference.

Inagural function of ICONTOX 2008 (L-R: Dr. Alok Dhawan, Dr. Mukul Das, Dr. Ashwani Kumar, Prof. A.S. Brar, Dr. Nitya Anand, Dr. Sally S. Tinkle, Prof. James M. Tiedje, and Dr. Rishi Shanker.

At the Inaugural Session on February 5, 2008, Dr Ashwani Kumar, Acting Director, Indian Institute of Toxicology Research, Lucknow welcomed the delegates. Dr Mukul Das, President, Indian Nanoscience Society gave the genesis of conference. The conference was inaugurated by the Chief Guest, Prof. A.S. Brar, Vice Chancellor, University of Lucknow. In his Inaugural Address, Prof. Brar mentioned that humans are at greater risk of exposure to nanomaterials which can enter the biological system through different routes. He emphasised the need to assess their safety during synthesis as well as during their release into the environment. A special issue of the journal "Nanotoxicology" containing

Dr Nitya Anand inaugurating the ICONTOX 2008 by lighting the lamp

abstracts of the conference was released by him. Dr Nitya Anand, Former Director, Central Drug Research Institute, Lucknow in his Presidential address remarked that nanomaterials hold a tremendous prospect of use in daily life in diverse fields including delivery systems for drugs, agro-chemicals, cosmetics and construction. He emphasized the need of proper investigations into the effects of exposure to new nanomaterials on human health.

Dr Sally S. Tinkle, Chair, NIH Nano Task Force Health Implications working group, National Institute of Environmental Health & Safety / National Institute of Health (NIEHS/NIH), U.S.A. delivered the Nanoscience Oration on "Harnessing the Power of Nanotechnology for Human Health". She also launched the website of Indian Nanoscience Society (www.nanoscience.ac.in) along with Dr Rishi Shanker, Vice President of the Society and the chairman, scientific programme committee. Prof. James M. Tiedje, Director, Center for Microbial Ecology, Michigan State University, U.S.A. while delivering the Keynote Lecture entitled "Lessons from the Microbial World for Sustainable Development and Use of Nanomaterials" highlighted the principles that are designed to minimize the impact of engineered nanomaterial technology on human health and the environment, with special emphasis on microbes and microbial genomics as potential markers for the purpose. Dr Alok Dhawan, Organizing Secretary, proposed a vote of thanks.

Dr Sally S. Tinkle, and Dr Rishi Shanker launching the website of the Indian Nanoscience Society.

Prof. Pancham Pramanik, Indian Institute of Technology, Kharagpur, set the tone of the first session on Nanomaterial Synthesis and Characterization by speaking on Co-ordination Chemistry for Nano-material Synthesis. He highlighted the synthesis of nanocatalysts and nanosensors for daily use through interactions between metal ions or molecules of inorganic / organic origin. This was followed by lectures by different speakers on various aspects of nanomaterials. The second session was on Nanomaterials in Pharmaceuticals. The plenary lecture on Nanoscience and the Design of Medicines was by Prof. Peter York of Institute of Pharmaceutical Innovations, U.K. He described various methods available to generate nanoparticles of drug substances including microfluidics and sonification techniques. This was followed by an invited lecture of Prof. Denis Labarre of Université Paris Sud, France, on Modifying Surface Properties can Turn a Foreign Body into a Smart Nanoparticle.

On the second day, two important sessions on Models and Sensors in Nanomaterial Safety / Toxicology were organized. Prof. Marcello Lotti of Università degli Studi di Padova, Italy in his plenary talk on Short-Term Effects of Particulate Matter: An Inflammatory Mechanism discussed in detail how the diversity of PM characteristics, dose metrics and endpoints hamper a clear discerning of inflammatory mechanism(s). Dr Syed A. Hashsham of Michigan, U.S.A delivered the plenary lecture on Emerging Genomic Tools for Nanotoxicology. He discussed the expression arrays, single cell genomics approach to measure low abundance transcripts, high throughput quantitative PCR, genotoxicity assay, and bioinformatic tools enabling enhanced capabilities for functional genomics. There were more than twenty speakers in this session.

On the third day the session entitled "Ethical and Regulatory Issues in Nanomaterial Toxicology" commenced with the plenary lecture Nanomaterials – History, Hype and Hysteria by Dr Paul Thorning of University of Bradford, UK. He enlightened the audience with the major therapeutic advances in nanomaterials and nanoparticles in addressing many challenges of poorly-soluble drugs. The concluding lecture of the session was by Dr. S. Ajmani, VLife Sciences Technologies, Pune on Understanding Toxicity Aspects of Molecules Using Novel Group Based QSTR (GQSTR) Approach.

At the Valedictory Session the Chief Guest was Dr Herald F. Krug, Switzerland, who pined that such meetings would evolve more collaborations and interactions for development and application of strategies for *in vitro* and *in vivo* safety and toxicity assessment of nanomaterials. Dr P. S. Chauhan while presiding lauded the efforts of Indian Nanoscience Society and IITR in organizing ICONTOX-2008, the first conference on Nanomaterial Toxicology in the country. He appreciated the efforts of Indian Nanoscience Society (INS) in publication of abstracts and subsequently selected papers in the Francis & Taylor Journal: Nanotoxicology. Dr Mukul Das, President INS acknowledged the overwhelming response of delegates from 11 countries to INS's first event-ICONTOX-2008 in delving over the imperative issue of nanomaterial safety. Dr Herald F. Krug and Dr PS Chauhan presented the Poster Awards to six participants - Mr. Girish Gupta (CDRI, Lucknow), Mr. Anurag Jyoti (IITR, Lucknow), Ms. Vyom Sharma (IITR, Lucknow), Ms. Virginia D'Britto (NCL, Pune) and Ms. Prachi Joshi (NPL, New Delhi). The session concluded with vote of thanks by Dr Alok Dhawan.

Visit of Vietnamese delegation

A six member delegation from Vietnam visited IITR on Nov. 5, 2007. The delegation was headed by Prof. Chau Van Minh, Director, Institute of Chemistry & Natural Products, Vietanamese Academy of Science & Technology (VAST), Mr Chu Tri Thang, Director, International Cooperation Department, VAST, Dr Hoang Nghia Son, Director, Institute of Tropical Biology, VAST; Dr Nguyen Quang Liem, Deputy Director, Institute of Material Sciences, VAST and Mr Dinh Thanh Trung, of International Cooperation Department, VAST.

Vietnamese delegation with the Acting Director and IITR scientists

Dr Ashwani Kumar, Acting Director, IITR welcomed the delegation and gave brief overview of the research activity of IITR. The delegation had discussion with scientists of IITR on possible collaborations in the following areas:

Lab visit of Vietnamese delegation

(1) Safety evaluation of natural products
(2) Assessment and management of drinking water quality
(3) Ecotoxicity analysis and risk assessment
(4) Analysis of pesticides, heavy metals and other contaminants in air, water, soil and food

CSIR Programme on Youth for Leadership in Science (CPYLS)

The CSIR Programme on Youth for Leadership in Science (CPYLS) was organized from 29-30 January, 2008. Out of the eighteen students selected from the merit list of U.P. Board, CBSE and ICSE Boards' class X examination of 2007, the following participated in this programme: Aashish Agarwal, Ambuj Singh Gangwar, Anurag, Himanshu Chaturvedi,

Keshav Mohta, Nidhi Tripathi, Prashant Tripathi, Pratibha Sharma, Shivendu Mishra, Vineet Pandey, Yutika Singh, (all from BNSD Shiksha Niketan Inter College, Kanpur); Suprabh Shukla (Seth M.R. Jaipuria School, Lucknow), Syed Ali Rizvi (Unity College, Lucknow), Anuj Kumar Singh Sengar (Bal Vikas Sansthan Higher Secondary School, Auraiya) Shanky Jaiswal (Chinmay Vidyalaya, Unchahar), Rajat Sharma (St John's School, Varanasi). All the children belonged to the mathematics stream.

Dr Ashwani Kumar, Acting Director, IITR, while welcoming the students and their parents, emphasized on the importance of science and technology for the growth of the country. He briefed the gathering about the need of such a programme that has been designed to encourage class X students to continue their scientific pursuits and interest in science as they prepare for college. He also briefed the students on various research areas in which the Institute is working. This was followed by screening of the film, 'Battling the Toxicants' which is a window to IITR's research programmes. The chief guest, Prof. Susheel Kumar, IIM-Lucknow, delivered a popular lecture on acquiring leadership in science. He captured the attention of everyone as his talk had a generous sprinkling of anecdotes making it an interesting and lively interactive session. Prof Kumar also emphasized on the importance of scientific knowledge for the growth of the country. Dr Sushil Kumar, Dy. Director & Chairman HRDC, IITR proposed a vote of thanks at the end of the inaugural session. A talk entitled “Microbes: friends or foes” was delivered by Dr Rishi Shankar. This was followed by visit to various laboratories and facilities in order to acquaint the students with modern approaches to toxicology research and also the impact that toxicants and pollutants have on human health at molecular and genetic levels. Techniques for detecting and quantifying chemicals and toxicants, and environmental pollutants were shown in Dyes & Food Adulterants laboratory and Environmental Monitoring Division.

Participants of CPYLS with the Acting Director

On the second day, students were taken to the Gheru Campus where they interacted with the scientists in the Environmental Chemistry & Waste Water Analysis Lab and were also shown the Animal House Facility. Students also attended a talk delivered by Dr Dinesh Mohan, Scientist IITR, on Environmental pollution control: issues and challenges. On return

to main campus, students visited Herbal Research, Developmental Toxicology, and Photobiology laboratory where microassays for high throughput screening of antioxidant potential of natural products, safety evaluation of plastics, and phototoxic effects on seed germination, pollination using cell lines were demonstrated.

Prof. Susheel Kumar delivering the lecture

A valedictory function was held later in the evening where the students expressed their views on their experience of the two days' programme. The children were impressed and fascinated by the working facilities, and state-of-the-art techniques being used. While airing their opinion, students expressed satisfaction and gratitude towards the CPYLS programme. One of the students who had plans of becoming an engineer is "giving it a second thought" now, that is after getting to know the scope in integrating physics, computer science, and mathematics with biology. A suggestion was that such a programme should be accompanied with career counselling prior to class X, so that the students get enough time to decide subjects of their choice. All the students marveled at the patience displayed by scientists in answering their queries. The Chairman, HRDC of the Institute presented momentos and certificates to CPYLS participants and concluded the event with an open invitation to them to visit IITR anytime they wish, interact with scientists here, and also participate in any activity organized by this Institute.


Participants of CPYLS interacting with scientist

HRD

Annual Events

World Environment Day

The World Environment Day was celebrated at Industrial Toxicology Research Centre (Presently-IITR) on June 5, 2007. Dr CM Gupta, Director-in-charge ITRC welcomed the guests. Prof. AK Tyagi, Department of Biochemistry, University of Delhi South Campus, New Delhi, and receipient of Dr CR Krishna Murti memorial lecture award. Prof. PK Seth, CEO Biotech Park, Govt. of UP, Lucknow, and president of the function, Dr GG Sanwal, Former-Head Department of Biochemistry, Lucknow University, were the guest of honour.

Dr PK Seth releasing the Industrial Toxicology Bulletin

On this occasion, Prof AK Tyagi released the report entitled "Assessment of environmental status of Lucknow city-pre-monsoon survey. Prof PK Seth released the issue of the six-monthly "Industrial Toxicology Bulletin" of the centre.

Dr SC Barman, Scientist, Environmental Monitoring Division, IITR presented the "Environmental status report of Lucknow city". A brief summary of the report is:

The study was conducted during May, 2007. The air quality with respect to Suspended Particulate Matter (SPM), Respirable Particulate Matter (RSPM), Sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) was monitored at 10 locations comprising 4 residential, 5 commercial and 1 industrial area. Noise level was also monitored at 12 locations, in addition to the 10 air monitoring locations one each at commercial and industrial area. The quality of drinking water (piped supply and ground water) was also assessed with respect to coliform and faecal coliform for 100 samples collected from residential, commercial and industrial areas.

The results showed that the 24 hrs mean SPM and RSPM level at all the locations (except industrial area for SPM) were found to be higher than the National Ambient Air Quality Standard (NAAQS) recommended by Ministry of Environment and Forests (MoEF), New Delhi which were 66.9 and 75.2% for SPM and RSPM respectively in residential area, 115.9 and 92.8% for SPM and RSPM respectively in Commercial area. In industrial area, it was little higher only for RSPM (4.7%) than NAAQS. The SO_2 and NO_x level were found to be below the NAAQS which is for both the pollutants is 80 µg/m^3 for residential and commercial areas and 120 µg/m^3 for industrial area. The RSPM levels were found to be higher than the previous year's level in 3 out of 4 in residential area, 3 out of 5 in

commercial and only at one location in industrial area whereas in case of SO_2 and NO_x showed little lower value except 2 locations in residential area for SO_2.

The noise level dB(A) at all the residential and commercial areas were found to be higher than their respective permissible limit recommended by Central Pollution Control Board, Delhi which is 55 and 45 dB(A) for residential and 65 and 55 dB(A) for commercial area during day and night time respectively. Among the two industrial areas only Talkatora recorded little higher value 77.8 dB(A) than the prescribed limit during day time 75.0 dB(A). The noise level during day and night time showed mixed trend with little variations over the previous year's level.

Among the 100 water samples, 34 were found to be contaminated. In residential area 13 out of 40 samples, in commercial13 out of 30 and in industrial area 8 out of 30 samples were found to be contaminated. Among piped 21 out of 50 and in ground water 13 out of 50 samples were found to be contaminated.

Dr GG Sanwal, President, Society of Biological Chemists, Lucknow Chapter and the guest of honour at the oration, briefly presented the background of the oration highlighting the achievements of Dr CR Krishna Murti. He also informed that the local chapter of Society of Biological Chemists is organising this oration at IITR.

Prof AK Tyagi delivered the XI Dr CR Krishna Murti Memorial Oration entitled “Gene regulation in mycobacteria and development of tuberculosis vaccine”. Prof Tyagi said that five decades of TB control programmes using efficacious drugs have not succeeded in reducing the prevalence of tuberculosis. Development of new drugs which could respond to MDR-TB was urgently needed as no new drug had emerged after the discovery of rifampicin in 1967. "Perfect strategies” for early diagnosis of TB are not available as yet and a perfect vaccine, which would be most effective in the control of tuberculosis, has eluded us all the time. The failure in developing new drugs and vaccines has not been due to lack of efforts. In fact, over the last couple of decades, there has been tremendous progress in understanding the biology of Mycobacterium”. However, there were questions which are still seeking answers. “The post-genomic era has seen tremendous development at an extremely rapid pace and we can hope that the coming years will witness the taming of this 'Captain of Death'” added Prof Tyagi.

He further stated that his group is focussing on structure and function of mycobacterial transcriptional signals, designing and construction of vectors for study of mycobacterial molecular genetics, gene knock-outs, expression of genes in mycobacteria.

Development of candidate vaccines against TB by using recombinant BCG, DNA vaccines and heterologous prime boost approach and identification and characterization of genes involved in the establishment of the disease.

Prof PK Seth while delivering the presidential address, talked about the theme of World Environment Day “Melting ice” and how global warming is having an impact on it. He

praised ITRC for developing database of environmental status of Lucknow city for the last 11 years. He suggested a need to develop a database on health effects of environmental pollution.

Dr Ashwani Kumar, Deputy Director and Chairman organizing committee proposed the vote of thanks. The day's activities also included a "Painting Competition" for children of class 1 to 10 on the theme "Melting Ice" and prizes were distributed.

65th CSIR Foundation Day

CSIR Foundation Day Function was held in the auditorium of Industrial Toxicology Research Centre (Presently IITR) on September 26, 2007. Dr D.K. Saxena, Chairman of the Organizing Committee gave the genesis of the CSIR Foundation Day.

Children participating in the painting competition

On this occasion officials of ITRC who had completed 25 years of service and also those who had superannuated were honoured by Dr Ashwani Kumar, Acting Director, ITRC, Lucknow. There were sixteen officials who had superannuated while 27 officials had completed 25 years of service. Dr Ashwani Kumar also awarded prizes to the following children.

Mr. Utkarsh Upadhayay s/o Mr. Dwijendra Upadhaya for securing over 90% marks in science subjects in the Class XII exam. (Cash prize of Rs. 2000/-)

Ms. Manika Singh D/o Dr L.K.S. Chauhan for securing over 90% marks in Mathematics in the Class XII exam. (Cash prize of Rs. 1000/)

Dr R.K. Upreti, Convener of the programme proposed the vote of thanks.

In the afternoon, a joint function of the Lucknow based CSIR labs including Central Drug Research Institute (CDRI), Central Institute for Medicinal and Aromatic Plants (CIMAP), Industrial Toxicology Research Centre (ITRC) and National Botanical Research Institute (NBRI), was held at the Scientific Convention Centre, Lucknow.

Delivering the Foundation Day lecture, JC Bose National Fellow, Prof Raghvendra Gadagkar of the Centre for Ecological Sciences, IISc., Bangalore, highlighted various points to be learnt from insects by mankind. Prof. Gadagkar said: "Many insects such as ants, bees, wasps and termites live in societies that parallel, if not better, human societies in sophistication and complexity of their organisation, communication, division of labour and even their caste system"

CSIR Foundation day function
D.K. Saxena, Ashwani Kumar, R.K.Upreti

Commenting on an insect's society, Prof Gadagkar said, "Insect society displays cooperation and conflict, altruism and self-sacrifice, they have invented a symbolic language, routinely solve complex navigational problems and even practice a sophisticated form of agriculture". Prof Gadagkar also highlighted ways of how insects accomplish their magnificent feats.

Earlier, Dr S.P.S. Khanuja, Director, CIMAP highlighted the achievements of all the four CSIR labs in Lucknow. Prof. S.S. Agarwal, former Director, Sanjay Gandhi Post-Graduate Institute of Medical Sciences, Lucknow presided over the function.

Mr Utkarsh Upadhyay with Director and his father Mr Dwijendra Upadhyay
[after receiving the award for securing more than 90% marks in 12th Board, 2007]

ITRC Celebrated 42nd Foundation Day

Industrial Toxicology Research Centre (ITRC) celebrated its Foundation Day on November 4, 2007. Earlier in the day, the 11th Prof SH Zaidi Oration was delivered by Dr Amit Ghosh, Director, School of Biological Sciences, Indian Institute of Advanced Research, Ahmedabad. Dr PS Chauhan, Former- Head, Department of Genetics, Bhabha Atomic Research Centre (BARC), Mumbai was the Chief Guest on the occasion. Dr Ashwani Kumar, Acting Director, ITRC while welcoming the guests opined that Prof Zaidi was a visionary, who was instrumental in setting up of ITRC and we hold this oration every year in his honour.

Dr Amit Ghosh, while delivering the oration entitled "Global environmental change and the emergence and re-emergence of infectious diseases: the Cholera Paradigm", said that despite widespread optimism about the eradication demise of the infectious disease in the middle of the last century; microbial threat continues to emerge, re-emerge and persist. During the last four decades or so, apart from the emergence of about 40 odd new diseases, old diseases like cholera, diphtheria etc, have re-emerged in many parts of the world, from where they were thought to have disappeared long ago. Emergence and re-emergence of infectious diseases are the result of complex interplay of a variety of factors, among which man's interaction with the environment plays a major role. Growing human impact on the environment is altering our planet's geological, biological and ecological systems, giving rise to conditions which are conducive to disease emergence.

Dr PS Chauhan lighting the lamp on the occasion of Prof. SH Zaidi Oration

Prof S.H. Zaidi Oration: (L to R) Dr Poonam Kakkar, Dr Amit Ghosh, Dr P.S. Chauhan and Dr Ashwani Kumar

Dr P.S. Chauhan in his presidential address said that the founder Director, Prof. S.H. Zaidi had a vision since he felt the need of establishing a centre which could evaluate the safety of food, chemicals and a variety of substances used in the industry. Dr Poonam Kakkar, organizing secretary proposed the vote of thanks.

Dr P.S. Chauhan interacting with media persons

In the evening, the 42nd Foundation Day Function was held in the ITRC lawns. Dr Ashwani Kumar, welcomed the dignitaries Dr Amit Ghosh and Dr P.S. Chauhan and the distinguished guests. While presenting the Annual Report of the centre, Dr Ashwani Kumar said that the period of the report coincided with the completion of tenth five year plan of Government of India and ITRC has successfully completed all the projects of this plan period. During this period 13 Network Projects were completed, besides several in house R&D programmes, a number of grants-in aid, industry sponsored consultancy research and societal programmes were also undertaken during this period. He further said that during the present 11th Five Year Plan, we are undertaking two major research programmes namely, "Investigative Toxicology: New Paradigms" (Supra Institutional project) and the networked project, "Environmental Contaminants: New Screening Technologies and effects on Human Health", where ITRC is the nodal laboratory. Besides these, ITRC will be participating in six other network projects. In order to upgrade our facilities in the emerging areas of toxicology, the facilities for nano-material toxicology and in silico toxicity were established. Some significant highlights of the research activities during this period were:

(a) Genetic polymorphism in Indian population for differential response to toxicants and susceptibility to different diseases was studied to identify the population susceptible to squamous cell carcinoma of head and neck in north Indian population.

(b) PCR protocols were developed for the detection of a transgene in genetically modified maize and RR Soya, which can be applied in other genetically modified food products.

(c) Chemical analysis of repeated fish fried oil showed presence of various carcinogenic polycyclic aromatic hydrocarbons.

(d) Silymarin, a herbal antioxidant showed hepatoprotective effect against hepatotoxicity that was induced by selected drugs like Rifampicin and Pyrogallol in mouse liver.

(e) Water quality variables and major classes of contaminants in samples collected from shallow and deep aquifers from Kanpur city were estimated and it was found that both types of aquifers in industrial areas are considerably contaminated with various chemicals.

(f) A new model of Indian earthworm towards acute toxicity testing of xenobiotics was developed.

In the foundation day address, Dr Amit Ghosh tried to identify the reasons behind

declining interest about science in the students. He said that nowadays the student chooses a subject not because it is his choice but because what others or the society wants him to choose. Thus many of them are taking up science as a career not because they are motivated but because what is valued by the society. He stressed on better value system for our younger generation.

Releasing the Annual report : (L to R) Dr D.K. Saxena, Dr Amit Ghosh, Dr P.S. Chauhan and Dr Ashwani Kumar

Dr. Amit Ghosh delivering the foundation day address

Dr P.S. Chauhan in his presidential address appreciated the research progress of ITRC, and said that the R&D programmes of the institute should also be technology oriented. He gave an overview of the unprecedented developments in toxicology in the last two decades. He further said that there are certain basic issues in toxicology which need to be addressed namely low and high dose effects and threshold limits among others. Dr D.K. Saxena, Dy. Director and Chairman of the Organising Committee proposed the vote of thanks.

National Science Day, Feb. 28, 2008

The National Science Day was celebrated at Indian Institute of Toxicology Research (IITR), Lucknow on February 28, 2008. On this occasion an exhibition showcasing the research activities of the institute was arranged. Prof. Roop Rekha Verma, an eminent educationist/social activist and former Vice Chancellor, University of Lucknow, inaugurated the exhibition. Around 150 children from various schools of the city visited the exhibition and interacted with the scientists. The Major exhibits were:

- Demonstration of colour detection strip (CD Strip), developed by IITR for the detection of non-permitted, carcinogenic oil soluble dye, Butter Yellow in mustard oil. Presence of several permitted (Carmoisine, Brilliant Blue FCF, Tartrazine, Ponceau 4R, Sunset Yellow etc.) and non-permitted colour (Rhodamine B, Orange II, Metanil Yellow, etc.) in various food commodities was also demonstrated by paper chromatography. Poster related to various adulterants e.g. argemone oil and

contamination of butter yellow in mustard oil were displayed.

- Bioactivity and safety evaluation of herbal formulations was demonstrated. Identification of medicinal plants by the combination of plant morphology and chemotyping of the metabolites was explained. Visitors were apprised about hepatoprotective and antidiabetic potential of plants.

Prof Roop Rekha Verma, former, Vice Chancellor, Lucknow University inaugurating the National Science Day exhibition

- The criteria involved in safety evaluation of plastic and polymeric materials, biosafety assessment studies of plastic and polymeric products and the mechanism involved in the plastic induced toxicity was explained to the visitors.
- Noise level monitor for recording of noise levels, Respirable dust sampler for monitoring of air pollutants, namely SPM, RSPM, SO_2 NO_x and Flue gas analyzer for analysis of particulate matter was demonstrated.
- Use of cell lines for evaluation photoxicity of drugs, and effect of UV radiation on the growth of maize and pulses (mung dal) was explained to the students.
- The technique for decolorization of effluent using certain species of bacteria was demonstrated through exhibit and posters.
- Body fat examination using bioelectric impedance analysis was performed for the school children and public. The examination included determination of body mass index as per WHO guidelines (1995) and Body fat percent and visceral fat level using Japan Society for Study of Obesity (2002) recommendations.

Prof Roop Rekha Verma, enquiring about the research activities at the exhibit

A film show entitled **Battling the Toxicants** which gives an overall view of the various activities of the institute, was also shown to the students.

Seminars

Sl. No.	Date	Name of Speaker	Topic
1.	April 17, 2007	Amita Mishra	Assessment of allergenic potential of leguminous food crops
2.	May 01, 2007	Brijesh Kumar Singh	Altered Mitochondrial Behavior: Effect of Calcium overload, glutathione depletion and oxidative stress
3.	May 08,2007	Mahendra P Singh	Induction of hsp70, oxidative stress markers and apoptotic cell death against benzene, toluene and xylene exposure in *Drosophila melanogaster*
4.	May 15, 2007	Neha Saxena	Dermal toxicological effect of Patulin
5.	May 22, 2007	Dwaipayan Sinha	Evaluation of chemical constituents and antioxidant potential of *Pinus roxburghii Sarg.* collected from different regions of Himalayas
6.	May 30, 2007	Dr Oladipo Ademuyiwa	Lead Effect on Some Aspects of Lipid Metabolism
7.	June 15, 2007	Rama S Dwivedi	Role of Epigenetics in Modern Medicine
8.	July 24, 2007	Rajeev Singh	Identification of immune-dominant antigen of outer-membrane-protein-fraction of *Salmonella typhimurium* in Salmonella induced reactive arthritis or undifferentiated spondyloarthropathy
9.	August 23, 2007	RK Singh	New 3 -D Human Bioassay Model for Drug Discovery and Therapeutics
10.	August 27, 2007	Jyotsna Singh	Physio-biochemical Markers for Cold Tolerance in Sugarcane
11.	August 27, 2007	Chetna Singh	An Introduction to yeast Two-Hybrid system
12.	September 5, 2007	Preeti Chaturvedi	Bacterial Diversity from Extreme habitats: A culturable approach
13.	September 5, 2007	Shailendra K Gupta	Bioinformatics approaches for Genomics & Proteomics
14.	September 11, 2007	Sanghamitra Bandyopadhyay	Neuro-inflammation and therapeutic in Alzheimer's disease model, Neuronal migration in GnRH neuron model, and brain development in hypothyroid model
15.	September 25, 2007	Alok Dhawan	Genotoxicity of C60 fullerenes
16.	September 25, 2007	Poonam Kakkar	Golden Triangle Partnership Project: An integrated approach
17.	October 29, 2007	Saleem Khan	Role of PcrA helicase in DNA transactions
18.	October 30, 2007	Hasan Mukhtar	Natural Products: Natures gift molecules for prevention and therapy of cancer
19.	November 23, 2007	Suman Patel	A microRNA feedback circuit in midbrain dopamine neurons (Kim et. al., 2007)

20.	November 23, 2007	Pushpa Lata	Integrated real-time PCR for detection and monitoring of *Legionella pneumophila* in water systems (Yaradou et. al., 2007)
21.	November 27, 2007	Preeti Srivastava	Chromosome Dynamics in *Vibrio cholerae*
22.	November 27, 2007	Sanjay Yadav	Mitochondrial targeting of Cytochrome P450
23.	November 30, 2007	Arvind Singh	MAIDI-TOF mass spectrometry for multiplex genotyping of CYP2B6 single-nucleotide polymorphisms (Blievernicht et. al., 2007)
24.	November 30, 2007	Abhai Kumar	BlotGlyco ABC^{TM}: An integrated glycoblotting technique for rapid and large-scale clinical glycomics (Niura et. al., 2007)
25.	December 4, 2007	Manoj K Pandey	Targeting NF-kappa B for prevention of inflammation and cancer
26.	December 4, 2007	Devendra K Patel	Solid-phase Micro-extraction: A tool for extraction and analysis of VOC's
27.	December 07, 2007	Chandra K. Singh	Protein microarrays (Chen & Zhu, 2006)
28.	December 07, 2007	Virendra Singh	Tumor invasion and metastasis initiated by microRNA-10b in breast cancer (Ma et. al., 2007.)
29.	December 14, 2007	Ashima Sinha	Selective inhibition of NF-kB activation prevents dopaminergic neuronal loss in a mouse model of Parkinson's disease. (Ghosh et. al., PNAS: 104; 2007; 18754-18759.)
30.	December 14, 2007	Ankit Macwan	Transposon-aided capture (TRACA) of plasmids resident in the human gut mobile metagenome. (Jones & Marchesi, Nature Methods: 4; 2007.)
31.	December 18, 2007	Brajesh Singh	Response of Microbial Community to Environmental Stress
32.	January 01, 2008	SC Chauhan	Magic bullets for Cancer treatment and diagnosis
33.	January 01, 2008	M Jaggi	Junctional Assembly in Cancer Progression
34.	January 04, 2008	Ashutosh Kumar	Transvascular delivery of small interfering RNA to the central nervous system. (Kumar et. al., Nature: 448; 2007; 39-43.)
35.	January 04, 2008	Ashutosh Pathak	Microarray based analysis of microbial community RNAs by whole community RNA amplification (WCRA). (Gao et. al., Appl Environ Microbiol: 73(2); 2007; 563-571.)
36.	January 11, 2008	Shilpa Tyagi	Type 2 Diabetes whole-genome association study in four populations: The DiaGen Consortium. (Salonen et. al., Am J Hum Genet: 81; 2007; 338-345.)
37.	January 11, 2008	Munindra Ruwali	Small interfering RNA-mediated silencing of mitochondrial $NADP^{+}$-dependent isocitrate dehydrogenase enhances the sensitivity of Hela cells toward tumor necrosis factor-alpha and anticancer drugs (Kil et. al., Free Radic Biol Med: 43(8); 2007; 1197-1207.)

38.	January 25, 2008	Raghuvir Singh Tomar	Dynamics of chromatin remodeling and transcriptional regulation of DNA damage response genes in Yeast
39.	January 31, 2008	Navin Khanna	Novel inexpensive test concepts for sensitive and specific detection of HIV, HCV, and HBV infections in a blood bank setting
40.	February 15, 2008	Preeti Srivastava	Life and works of Nobel Laureate Arthur Kornberg (1918-2007)
41.	February 15, 2008	Sanghamitra Bandhopadhayay	Alzheimer's Disease (AD)-like pathology in aged monkeys after infantile exposure to environmental metal lead (Pb): evidence for a Developmental Origin and Environmental Link for AD (Wu et. al., J Neurosci: 28(1); 2008; 3-9)
42.	February 22, 2008	RK Jain	Biochemical and molecular analysis of nitro aromatic degradation: Development of an in-situ bioremediation technology
43.	February 22, 2008	Sushila Patel	Changes in the level and distribution of Ku proteins during cellular senescence (Seluanov et. al., DNA repair: 6; 2007; 1740-1748)
44.	February 22, 2008	Ghanshyam Upadhyay	Peroxisome proliferator-activated receptor-β/δ protects against chemically induced liver toxicity in mice (Shan et. al., Hepatology: 47(1); 2008; 225-235)
45.	February 29, 2008	Prachi Bajpai	Overexpression of the heat-shock protein 70 is associated to imatinib resistance in chronic myeloid leukemia (Pocaly et. al., Leukemia: 21; 2007; 93-101)
46.	February 29, 2008	Preeti Roy	Serum proteomics study of the squamous cell carcinoma antigen 1 in tongue cancer (Huang et. al., Oral Oncology: 42; 2006; 26-31)
47.	March 07, 2008	Suchitra Kamle	Novel anti-dengue monoclonal antibody recognizing conformational structure of the prM-E heterodimeric complex of dengue virus (Puttikhunt et. al., J Med Virol: 80; 2008; 125-133)
48.	March 07, 2008	Vivek Misra	Sanguinarine-dependent induction of apoptosis in primary effusion lymphoma cells (Hussain et. al., Cancer Res: 67(8); 2007; 3888-3897)
49.	March 07, 2008	Ravi Ram Kristipati	Functional analysis of Seminal fluid proteins in Drosophila
50.	March 14, 2008	Rajesh Kumar	Detecting antigens by quantitative immuno-PCR (Niemeyer et. al., Nature Protocols: 2(8); 2007, 1918-1930)

51.	March 14, 2008	Manish Misra	An essential role for drosophila hus1 in somatic and meiotic DNA damage responses (Abdu et. al., J Cell Sci: 120; 2007; 1042-1049)
52.	March 20, 2008	Yogesh Awasthi	Novel approaches in radioprotection and cancer chemotherapy
53.	March 28, 2008	Kausar Mahmood Ansari	Prostaglandin E2 mediated signaling in skin carcinogenesis
54.	March 28, 2008	N Manickam	HCH Biodegradation :cloning and expression of a Haloalkane dehalogenase gene from a *Sphingomonas* species

Distinction

An article entitled "Regulation of p53, nuclear factor kappaB and cyclooxygenase-2 expression by bromelain through targeting mitogen-activated protein kinase pathway in mouse skin" by Kalra Neetu, Bhui Kulpreet, Roy Preeti, Srivastava Smita, George Jasmine, Prasad Sahdeo, Shukla Yogeshwer, was displayed on cover page of the journal "Toxicology & Applied Pharmacology", dated January 01, 2008.

Honours and Awards

- Dr Yogeshwer Shukla has been nominated to the Editorial Board of the journal, Cancer Letters.
- Dr Yogeshwer Shukla has been nominated to the Editorial Board of the journal, Tumor Biomarkers.
- Ms. Smita Srivastava, won the prize for the best poster presentation award on the paper entitled "Adverse health effects associated with dietary consumption of repeatedly boiled peanut oil" at the 33rd Annual Conference of Environmental Mutagen Society of India held at Aligarh Muslim University, Aligarh in January 2008.
- Dr A. K. Srivastava delivered Medichem IAOH Oration (Revisiting disease clusters) at the 58th National Conference of Indian Association of Occupational Health at Mumbai.
- Dr Virendra Misra, nominated as Member, Peer and Core Expert Committee, Central Pollution Control Board, Delhi.
- Dr Ashwani Kumar was nominated as Member- National Task Force for "Environmental Biotechnology and Biodiversity Conservation" of 'Department of Biotechnology', Government of India.
- Dr Ashwani Kumar was appointed Member- Research Council, National Environmental Engineering Research Institute, Nagpur.
- Dr D. K. Agarwal appointed Regional Coordinator of WHO-TDR GLP Network (Asia)-May 2007.

- Dr P. Kakkar was appointed as Scientist member of Crude Drug & Herbal Product Committee of Indian Pharmacopoeia Committee during its meeting in December, 2007.
- Dr Rishi Shanker was awarded "Certificate of Merit" by DG, CSIR on successful completion of CSIR Leadership Development Programme (01/08).
- Dr Mukul Das served as Chairman, Food Additives Section Committee, FAD 8, Bureau of Indian Standards, New Delhi, 2007-2008.
- Dr Mukul Das was elected as President, Indian Nanoscience Society, 2007-2009.
- Dr Mukul Das was elected as Editorial Board Member of Journal of Medicinal Plant Research, Academic Press, 2007-2008.
- Dr K. Gopal was appointed Vice –Chairman of State Level Environmental Appraisal Committee (SEAC), (U.P.), 2007- 2008.
- Ms. Sangeeta Yadav and Dr. Ram Chandra were awarded Gold medal for poster presentation at the National Conference organized by The Academy of Environmental Biology (27th annual session) held at Department of Zoology & Department of Environmental Science, Ch. Charan Singh University, Meerut. (U.P.) from October 26-28, 2007.

Intellectual Property Filed

Patents: Dhawan A; Pandey AK; Bajpayee M; Parmar M; Das M; Misra HO (2007). A device to measure separation of charged molecules. Patent Application Number – 0058NF2007.

Copyright: A database on Treatment & Antidotes for Chemical Poisoning. (Copyright submission no.: 14-CR-2008). Jaffery FN; Gupta SK; Shaw A; Naqvi SHN; Sharma A; Pattanayak M.

The aim of this database is to provide information on chemicals, their uses, properties, symptoms of exposure, antidotes, methodology of administration of antidotes in case of poisoining etc. First version of the database consists of 163 chemicals.

Ph. D. Awarded

S. No.	Name of Student	Supervisor	Title of thesis	University	Year of award
1	**Atul Kumar Singh**	Dr Ashwani Kumar	Cloning and characterization of genes encoding degradation of γ-hexachlorocyclohexane from *Pseudomonas aeruginosa* ITRC-5	Lucknow University	2007
2	**Hifzur Rehman Siddique**	Dr D. Kar Chowdhuri	Genetic and developmental studies in *Drosophila melanogaster* against selected environmental chemicals	Aligarh Muslim University, Aligarh	2008
3	**Shashi Prabha Dubey**	Dr Krishna Gopal	Use of natural products for the purification of drinking water	Lucknow University	2008
4	**Satish Chandra Shukla**	Dr Krishna Gopal	Development, safety evaluation and comparative studies of low cost adsorbent technology for arsenic removal from drinking water	H.N.B. University, Garhwal	2008
5	**Neeraj Agrawal**	Dr R.K. Hans	Role of reactive oxygen species in drug phototoxicity	Chhatrapati Shahuji Maharaj University, Kanpur	2007
6	**Bikramjeet Singh**	Dr R.K. Hans	Phototoxic assessment of antidiabetic drugs	Guru Nanak Dev University, Amritsar	2007
7	**A. Kannan**	Dr R.K. Upreti	Impact of industrial effluents on plant and animal cell surface membrane: toxicological evaluation and pollution abatement	Lucknow University	2007
8	**Ch. Kishore Babu**	Dr Mukul Das	Role of free radical induced oxidative stress in modulation of cellular response during argemone oil intoxication	Lucknow University	2007
9	**E. Naveen Prasad Reddy**	Dr Mukul Das	Studies on bio-metabolism of Argemone oil alkaloids	Lucknow University	2007
10	**Nishi Srivastava**	Dr A.K. Agarwal	Functional restoration by fetal neural cell transplantation in kainic acid induced rat model of cognitive dysfunction	Jiwaji University, Gwalior	2007

Ph. D. Awarded

S. No.	Name of Student	Supervisor	Title of thesis	University	Year of award
11	**Subhash Chandra Gupta**	Dr D. Kar Chowdhuri	Organosphosphate pesticides induced alterations in the expression of stress genes and interaction with other cellular agents in Drosophila	Lucknow University	2007
12	**Abhay Raj**	Dr Ram Chandra	Isolation and characterization of lignin degrading bacteria for the treatment of effluent from pulp and paper mill	Lucknow University	2007
13	**Shail Singh**	Dr Ram Chandra	Bacterial degradation of phenol and pentachlorophenol in pulp paper mill waste	Pt. Ravishankar Shukla University, Raipur	2007
14	**Ramesh Singh**	Dr S.K. Bhargava	Responses of plants of industrial effluents: factors influencing phyto-remediation	Ambedkar University, Lucknow	2007

Visits Abroad

- Dr Ashwani Kumar, Acting Director visited Masaryk University, Brno, Czech Republic, under Bilateral Exchange Programme of 'Indian National Science Academy' and 'Academy of Science of the Czech Republic' during October 4 to 30, 2007 to conduct research focussed on molecular modeling for the improved biodegradation of persistent beta HCH isomer of the chlorinated insecticide hexachlorocyclohexane.
- Dr Jai Raj Behari, Scientist visited Cambodia and Vietnam from November 2 to 23, 2007 as an expert of FAO to undertake short term assignment to prepare and conduct a workshop on chemical risk assessment.
- Dr D. Kar Chowdhuri, Scientist visited United Kingdom from July 20 to 31, 2007 to discuss detailed work plan of the UK-IERI Major Research Award Project (MA-03) awarded by British Council/UKIERI with UK PI and other collaborating scientists.
- Dr K. C. Khulbe, Scientist, RPBD visited Turin, Italy and Geneva, Switzerland from September 3 to December 13, 2007 under study leave for Master of Laws in Intellectual Property.
- Dr M. M. Krishna Reddy, Scientist was deputed to Medicinal Chemistry Drug Discovery Core, The Sidney Kimmel Comprehensive Cancer Centre at Johns Hopkins, USA under BOYSCAST Fellowship of DST from March 23, 2007 for a period of 12 months.
- Dr Madhulika Singh, Research Associate, Proteomics Lab, attend the Australiasin Flow-cytometry Group 30th Annual Scientific meeting held at Melbourne, Australia from 16-19 September 2007.
- Prachi Bajpai, CSIR-SRF working visited Singapore to attend 18th Wonca World Conference 2007 from July 24 – 27,2007
- Mr. N. Manickam, Scientist visited the Environmental Microbiology Centre, Technical University Bergacademy, Freiberg, Germany, for the period October –December 2007 under Indian National Science Academy (INSA) and German Research Foundation (DFG) Fellowship programme.

Externally Funded Research Projects (2007-2008)

S. No.	Title	Funding Agencies	Principal Investigator
1	Mathematical and experimental modelling of the animal stress-response network	UKIERI, British Council	Dr. D. Kar Chowdhuri
2	Survey & analysis of asbestos fibre at MAML, Hoshiarpur	Mahavir Spinning Mills Ltd., Hoshiarpur	Dr. Iqbal Ahmad
3	Training programme in pesticide residual analysis for environmental scientistists	Tamil Nadu Pollution Congrol Board, chennai	Dr.R.C.Murthy
4	Molecular detection of transgenic plants	Nirmal Seeds Pachora	Dr. D. N. Kachru
5	Testing kit for detection of silver content in water after treatment through silver ionization plant	Bharti Waters Pvt Ltd , New Delhi	Dr.K.Gopal
6	Testing of silver-ionized water samples: efficacy of silver ionization for bacterial disinfection of drinking water	Bharti Waters Pvt. Ltd. New Delhi	Dr.K.Gopal
7	Health risk assessment and environmental monitoring amongst pesticide sprayers in mango plantation of U.P.	U.P. CST, Lucknow	Dr. C. Kesavachandran
8	Production and promotion of Neem based pesticides as environment friendly biodegradable alternatives to chemical pesticides - Neem Project Phase-II	Ministry of Chem. & Fertilizers, Deptt. Of Chemicals & Petrochemicals, Govt. of India, New Delhi	Dr. R.B. Raizada
9	Toxicogenomic of chromate carcinogenesis	ICMR, New Delhi	Dr. Sushil Kumar
10	Bioremediation of HCH contaminated soil near Chinhat Industrial Area in Lucknow	Black Smith Institute, USA	Dr. Ashwani Kumar
11	Development of biomarkers for predicting exposure of Diesel Exhaust Particles (DEP) by gene expression profilling	DRDE, Gwalior	Dr. Devendra Parmar
12	Genetic polymorphism of Glutathione-S-transferases and risk of gastric cancers in Indian population	UPCST, Lucknow	Dr. Deepa Agrawal
13	Studies on the expression and regulation of xenobiotic metabolizing cytochrome P-450s in human brain cells	UPCST, Lucknow	Dr. A.B. Pant & Dr. D. Parmar

S. No.	Title	Funding Agencies	Principal Investigator
14	Development of molecular tools for detection of GM Foood	DBT, New Delhi & Min. of Health & Family Welfare, New Delhi	Dr. D.N. Kachru
15	*In vivo* estrogenic activities of femarimol : Protective role of an antioxidant melatonin	ICMR, New Delhi	Ms. Nahid Akhtar Dr. R.B. Raizada
16	Flow cytometric analysis of DNA ploidy and cell cycle mucosal cells of smokeless tobacco consumers and role of dietary phytochemicals in oral cancer prevention	ICMR, New Delhi	Mr. Harjeet Singh Mann & Dr. Y. Shukla
17	WHO-TDR GLP Network Regional Co-ordination (Asia) Programme	WHO, Geneva, Switzerland	Dr. Deepak Agarwal
18	Antifibrotic potential of select herbal compounds efficacy and mode of action in experimental hepatic fibrosis rat models	ICMR, New Delhi	Dr. S. Khandelwal
19	Characterization of inhibitory factors for improvement of bacterial degradation of lignin and pentachlorophenol from pulp paper effluent and its application for ferti-irrigation	DBT, New Delhi	Dr. Ram Chandra
20	Pilot scale optimization of bacterial degradation of lignin and pentachlorophenol for pulp paper effluent decolourization and its application for aqua culture and ferti-irrigation	MOEF, New Delhi	Dr. Ram Chandra
21	Development of DNA and protein based assays for detection of transgenic vegetative insecticidal protein (vip) in genetically modified plants/foods and elevation of their potential allergenicity	ICMR, New Delhi	Dr. D.N. Kachru & Ms. Suchitra
22	Prenatal sensitivity of cerebral and hepatic cytochrome P-450(CYPs) influences the developmental neurotoxicity of cypermethrin	ICMR, New Delhi	Dr. D.Parmar & Mr.Y.Sachan
23	Effect of caffeine on microglial activation and secondary signaling mediators in maneb and paraquat induced Parkinsons's disease phenotype in mouse	DBT, New Delhi	Dr.M.P.Singh

Externally Funded Projects

S. No.	Title	Funding Agencies	Principal Investigator
24	Fate of nanomaterials in biological systems	DST. New Delhi	Dr. Alok Dhawan
25	Studies to explore antihepatotoxic and antioxidative potential of probiotic lactic acid bacteria(LAB)	ICMR, New Delhi	Dr. Poonam Kakkar & Ms. Sapna Sharma
26	Determination and Characterization of Developmental neurotoxicity of environmental toxicants such as heavy metals and pesticides	ICMR, New Delhi	Dr. Sanghamitra Bandhopadhyay and Mr. Asit Rai
27	The effect of environmental stressors, natural and pollutional on the early life stages on Indian major carp *Cyprinus carprio* and Rohu(Llabeo Rohita)	U.P.C.S.T. Lucknow	Dr. B.S. Khangarote
28	Role of heavy metal resistant lactobacillus stains in gastrointestinal toxicity	ICMR, New Delhi	Dr. R.K. Upreti
29	Short term dermal toxicity of plants extracts	Assam Agricultural University, Khanpara, Guwahati, Assam	Dr. R.B. Raizada
30	Acute Toxicity of Micromole CMF-90	Micromole Ionic Pvt. Ltd., Ahmedabad	Dr. R.B. Raizada
31	Toxicological studies of Maxfloc-T and Maxfloc-TG	Thermax Ltd., Pune	Dr. R.B. Raizada
32	Toxicological studies of MAK all season HMO	Bharat Petroleum Corporation Ltd., Mumbai	Dr. R.B. Raizada
33	Analysis of Zn in human serum samples	SGPGIMS, Lucknow	Dr. D.K. Patel
34	Safety evaluation of KEMFLOC-305M	Chembond Drewtreat Ltd., Navi Mumbai	Dr. V.P. Sharma
35	Monitoring of envrionmental parameters	Kanoria Chemical & Industries Ltd., Renukoot	Dr. S.K. Bhargava
36	Third party testing and monitoring of stack emission,ambient air and water effluent testing and annual environmental audit	UPRVUNL, ATPS, Anpara	Dr. S.C. Barman
37	Monitoring of environmental parameters of HIL-RPD, Renusagar	Hindalco Industries Ltd., Renusagar	Dr. S.K. Bhargava
38	Monitoring of pollution parameters by outside laboratory at NTPC, Rihandnagar	NTPC, RSTPP, Rihandnagar	Dr. G.C. Kisku
39	Analysis of ground water to ascertain their potability	U P Ground Water Deptt. Allahabad	Dr.Kr. P.Singh
40	Preparation of environmental audit reports for the year 2006-07 on annual and monthly basis	Panki Thermal Power Station, Kanpur	Dr.S K Bhargava

S. No.	Title	Funding Agencies	Principal Investigator
41	Toxicological evaluation of polyelectrolytes Magnafloc LT-610 and LT-27	Ciba India Ltd,Mumbai	Dr.V.P.Sharma
42	3rd party testing of stack emission ambient air monitoring and effluent water testing including preparation of annual environmental audit report of unit 1,2,3,&4 of PTPP	PTPP,UPRVUNL, Parichha	Er.A.H.Khan
43	Safety evaluation of Ethyl Vinyl Acetate	NCERT New Delhi	Dr.V.P.Sharma
44	Toxicological testing of GRP fibers	Amiantit, fibre glass , Bicholin Goa.	Dr.V.P.Sharma
45	Asbestos fibre counting in 10 slides.	North East Roofing Pvt.Ltd.,Banda, Narangi Guwahati.	Dr. Iqbal Ahmad
46	Estimation of pesticides and arsenic in human tissue and blood sample	Mahavir Cancer Sansthan, Patna.	Dr.J R Behari

Research Council (2007-2008)

Dr P.S. Chauhan Former Head, Department of Genetics BARC, Mumbai, RH No. 99, Plot # 99 Sector 18 A, NERUL (W) Navi Mumbai-400706	Chairman
Dr Navin Khanna Group Leader Mammalian Biology International Centre for Genetic Engineering and Biotechnology Aruna Asif Ali Marg New Delhi-110 067	Member
Prof Pradip Sinha Department of Biosciences and Bioengineering Indian Institute of Technology Kanpur-208016	Member
Prof Vijay K. Chaudhary Department of Biochemistry University of Delhi, South Campus Benito Juarez Road New Delhi-110021	Member
Prof R.C. Sobti Vice Chancellor Punjab University Chandigarh-160014	Member
Dr D.B.A. Narayana Head, Herbals Research, Hindustan Unilever Research Centre, 64, Main Road, Whitefield, Bangalore-560 066	Member
Dr T.S. Rao Adviser Department of Biotechnology Block II, 7th Floor, CGO Complex, Lodi Road New Delhi-110 003	Agency Representative

Dr. Rakesh Jain Scientist G Institute of Microbial Technology Sector 39 A Chandigarh-160036	DG's Nominee
Dr. T. Chakrabarti Scientist G National Environmental Engineering Research Institute Nehru Marg Nagpur-440 020	Sister Lab Representative
Dr. Ashwani Kumar Acting Director Indian Institute of Toxicology Research Lucknow	Member
Head **R&D Planning Division** Council of Scientific and Industrial Research 2, Rafi Marg, Anusandhan Bhavan New Delhi-110 001	Permanent Invitee
Dr. D.K. Saxena Scientist G Indian Institute of Toxicology Research Lucknow	Secretary

Management Council (2007-2008)

Dr Ashwani Kumar Acting Director IITR, Lucknow	Chairman
Dr Vinod Behari Scientist G CDRI, Lucknow	Member
Dr D.K. Saxena Scientist IV(6) IITR, Lucknow	Member
Dr (Mrs.) Deepa Agrawal Scientist IV(5) IITR, Lucknow	Member
Dr Rishi Shanker Scientist IV(4) IITR, Lucknow	Member
Dr Devendra Parmar Scientist IV(4) IITR, Lucknow	Member
Shri B.D. Bhattacharji Scientist IV(4) RPBD IITR, Lucknow	Member
Shri Yogendra Singh E.M.E. (Electrical) IITR, Lucknow	Member
Shri B.K. Mishra F&AO IITR, Lucknow	Member
Shri Tariq Qutubuddin Sr. C.O.A. IITR, Lucknow	Member Secretary

Publications

1. Agarwal R; Behari JR. Effect of selenium pretreatment in chronic mercury intoxication in rats. Bull Environ Contam Toxicol: 79; 2007; 306-310.
2. Agarwal R; Behari JR. Role of selenium in mercury intoxication in mice. Indust Health: 45; 2007; 388-395.
3. Agarwal R; Behari JR. Screening for mercury in aqueous environmental samples and urine samples using thin layer chromatography. Water Environ Res: 79; 2007; 2457-2463.
4. Agarwal R; Behari JR; Prakash R. Estimation of mercury in environmental and biological samples based on anodic stripping differential pulse voltammetry using a novel rotating side disk electrode. Trace Elem Electroly: 25; 2008; 79-85.
5. Ahmad I. Environmental hygiene and health status in talc-based industries in India: Technical review. Bulletin of Indian Society of Industrial Hygiene: 9; 2007; 1-3.
6. Ansari FA; Ashquin M; Ahmad I. Asbestos fiber counts in work zone area of asbestos cement factory, India. J Scientific & Industrial Research: 66; 2007; 935-937.
7. Ansari FA; Ashquin M; Khan AH; Prasad R; Siddiqui H; Ahmad I. Assessment of asbestos emission in occupational and ambient environment by asbestos cement roofing sheet industry. Chemical & Environmental Research: 16; 2007; 95-102.
8. Babu K; Khanna SK; Das M. Adulteration of mustard cooking oil with argemone oil: Do Indian food regulatory policies and antioxidant therapy both need revisitation. Antioxidant Redox Signalling: 9; 2007; 515-525.
9. Bajpai P; Tripathi AK; Agrawal D. Increased frequencies of Glutathione-S-Transferase (GSTM1 & GSTT1) null genotypes in Indian patients with Chronic Myeloid Leukemia. Leukemia Res: 31; 2007; 1359-1363.
10. Barthwal J; Nair S; Kakkar P. Heavy metal accumulation in medicinal plants collected from environmentally different sites. Biomed Environ Sci: 21; 2008; 319-324.
11. Bhargav D; Singh MP; Murthy RC; Mathur N; Misra D; Saxena DK; Kar Chowdhuri D. Toxic potential of municipal solid waste leachates in transgenic *Drosophila melanogaster* (hsp70-lacZ): hsp70 as a marker of cellular damage. Ecotoxicol Environ Saf: 69; 2008; 233-245.
12. Bhargava RN; Chandra R, Rai V. Phytoextraction of trace element and physiological changes in Indian mustard plant (*Brassica nigra L.*) grown in post methanated distillery effluent (PMDE) irrigated soil. Bioresource Tech: 99; 2008; 8316-8324.
13. Bhattamisra SK; Khanna VK; Agrawal AK; Singh PN; Singh SK. Antidepressant activity of standardised extract of *Marsilea minuta Linn.* J Ethanopharmacol: 117; 2008; 51-57.

14. Chandra R; Bharagava RN; Rai V. Melanoidins as major colourant in sugarcane molasses based distillery effluent and its degradation. Bioresource Tech: 99; 2008; 4648-4660.
15. Chandra R; Yadav S; Bharagava RN; Murthy, RC. Bacterial pretreatment enhances removal of heavy metals during treatment of post-methanated distillery effluent by *Typha angustata L.* J Environ Management: 88 : 2008; 1016-1024.
16. Chandra R; Yadav S; Mohan D. Effect of distillery sludge on seed germination and growth parameters of green gram (*Phaseolus mungo L.*). J Hazardous Material: 152; 2008; 431-439.
17. Chaturvedi PK; Seth CS; Misra V. Selectivity sequences and sorption capacities of phosphatic clay and humus rich soil towards the heavy metals present in zinc mine tailing. J Hazardous Materials: 147; 2007; 698-705.
18. Chaturvedi RK; Shukla S; Seth K; Agrawal AK. Zuckerkandl's organ improves long-term survival and function of neural stem cell derived dopaminergic neurons in Parkinsonian rats. Exp Neurol: 210; 2008; 608-23.
19. Chaturvedi S; Chandra R; Rai V. Multiple antibiotic resistance patterns of rhizospheric bacteria isolated from *Phragmites australis* growing in constructed wetland for distillery effluent treatment. J Environ Biol: 29; 2008; 117-124.
20. Chauhan LKS; Kumar M; Paul BN; Goel S; Gupta SK. Cytogenetic effects of commercial formulation of detamethrin and/or Isoproturon on human peripheral lymphocytes and mouse bone marrow cells. Environ Mol Mutagen: 48; 2007; 636-643.
21. Dhawan A; Bajpayee M; Parmar D. Comet assay: A reliable tool for the assessment of DNA damage in different models. Cell Biol Toxicol: (doi - 10.1007/s10565-008-9072-z; 2008-04-22); 2008. (Epub ahead of print).
22. Gopal K; Murthy RC; Singh KrP; Bhargava SK. Status and intensity of ground water pollution in Uttar Pradesh. J Adv Zool: 29; 2008; 1-6.
23. Hans RK; Agrawal N; Verma K; Misra RB; Ray RS; Farooq M. Assessment of phototoxic potential of cosmetic products. Food Chem Toxicol: 46; 2008; 1653-1658.
24. Indian Genome Variation Consortium: Genetic landscape of the people of India: a canvas for disease gene exploration. J Genetics: 87; 2008: 3-20.
25. Johri A; Dhawan A; Singh RL; Parmar D. Persistence in alterations in the ontogeny of cerebral and hepatic cytochrome P450s following prenatal exposure to low doses of lindane. Toxicol Sci: 101; 2008; 331-340.
26. Johri A; Yadav S; Dhawan A; Parmar D. Responsiveness of cerebral and hepatic cytochrome P450s in rat offspring prenatally exposed to lindane. Toxicol Appl Pharmacol: 231; 2008; 10-16.

27. Kalra N; Bhui K; Roy P; Srivastava S; George J; Prasad S; Shukla Y. Regulation of p53, nuclear factor kappaB and cyclooxygenase-2 expression by bromelain through targeting mitogen-activated protein kinase pathway in mouse skin. Toxicol App Pharma: 226; 2008; 30-37.
28. Kalra N; Roy P; Prasad S; Shukla Y. Resveratrol induces apoptosis involving mitochondrial pathways in mouse skin tumorigenesis. Life Sci: 82; 2008; 348-358.
29. Kannan A; Upreti RK. Influence of distillery effluent on germination and growth of mung bean *(Vigna radiata)* seeds. J Hazard Mat: 153; 2007; 609-615.
30. Kesavachandran C; Rastogi SK; Mathur N; Bihari V. Sub-clinical upper and lower airway diseases among workers exposed to welding operations. ICFAI Life Sci: 1; 2008; 60-66.
31. Khan A; Shukla Y; Kalra N; Alam M; Ahmad MG; Rashid S; Owais M. Potential of diallyl sulfide bearing pH sensitive liposomes in chemoprevention against DMBA induced skin papilloma. Mol Med: 13; 2007; 443-451.
32. Kumar A; Upadhyay G; Modi DR; Singh MP. The involvement of secondary signaling molecules in cytochrome P-450 1A1-mediated inducible nitric oxide synthase expression in benzo(a)pyrene-treated rat polymorphonuclear leukocytes. Life Sci: 81; 2007; 1575-84.
33. Kumari A; Kakkar P. Screening of antioxidant potential of selected barks of Indian medicinal plants using multiple in vitro assays. Biomed Environ Sci: 21; 2008; 24-29.
34. Malik A; Ojha P; Singh KP. Distribution of polycyclic aromatic hydrocarbons in fish from Gomti river, India. Bull. Environ. Contam. Toxicol: 80; 2008; 134-138.
35. Malik A; Singh KP; Ojha P. Residues of organochlorine pesticides in fish from the Gomti river, India. Bull Environ Contam Toxicol: 78; 2007; 335–340.
36. Malik A; Singh VK; Singh KP. Occurrence and distribution of persistent trace organics in rainwater in an urban region (India). Bull Environ Contam Toxicol: 79; 2007; 639–645.
37. Manickam N; Ghosh A; Jain RK; Mayilraj S. Description of a novel indole oxidizing bacterium *Pseudomonas indoloxydans sp*. nov., isolated from a pesticide contaminated site. Sys App Micro: Mutat Res.,- FUND MOL M (doi:10.1016/j.syapm. 2008.02.002); 2008 .
38. Manickam N; Misra R; Mayilraj S. A novel pathway for the biodegradation of γ-hexachlorocyclohexane by a *Xanthomonas sp* strain IC12. J App Micro: 102; 2007; 1468-1478.
39. Manickam N; Reddy MMK; Saini HS; Shanker R. Isolation of hexachlorocyclohexane degrading *Sphingomonas sp.* by dehalogenase assay and characterization of genes involved in γ-HCH degradation. J App Micro: 104; 2008; 952–960.

40. Mathur N; Rastogi SK; Kesavachandran C; Agarwal GG. Prediction models for peak expiratory flow rates in North Indian male population: Models based on ordinary and weighted least square estimations. Curr Sci: 93; 2007; 959-963.
41. Mishra KK; Dixit S; Purshottam SK; Pandey RC; Das M; Khanna SK. Exposure assessment to Sudan dyes through consumption of artificially coloured chilli powders in India. Intl J Food Sci Technol: 42; 2007; 1363-1366.
42. Mishra S; Khanna VK; Kumar V. Benzodiazepine receptor binding and anxiolytic studies on Aniximin, A polyherbal formulation. J Cell Tissue Res: 8; 2008; 1491 – 1498.
43. Misra V; Chaturvedi PK. Plant uptake/bioavailability of heavy metals from the contaminated soil after treatment with humus soil and hydroxyapatite. Enviro Monit Assess: 133; 2007; 169-173.
44. Mohan D; Singh KP; Singh VK. Wastewater treatment using low cost activated carbons derived from agricultural byproducts - A case study. J Hazard Materials: 152; 2008; 1045-1053.
45. Nigam N; Prasad S; Shukla Y. Preventive effects of lupeol on DMBA induced DNA alkylation damage in mouse skin. Food Chem Toxicol: 45; 2007; 2331-2335.
46. Nigam N; Shukla Y. Preventive effects of diallyl sulfide on 7, 12-dimethylbenz[a]anthracene induced DNA alkylation damage in mouse skin. Mol Nutr Food Res: 51; 2007; 1324-1328.
47. Noel S; Sharma S; Shanker R; Rath SK. Primaquine-induced differential gene expression analysis in mice liver using DNA microarrays. Toxicol: 239; 2007; 96–107
48. Pant N; Shukla M; Kumar R; Patel D; Shukla Y; Mathur N; Gupta YK; Saxena DK. Correlation of phthalate exposures with semen quality. Toxicol Appl Pharmacol: 231; 2008; 112-116.
49. Patel S; Bajpayee M; Pandey AK; Parmar D; Dhawan A. *In vitro* induction of cytotoxicity and DNA strand breaks in CHO cells exposed to cypermethrin, pendimethalin and dichlorvos. Toxicol In Vitro: 21; 2007; 1409-1418.
50. Patel S; Sinha A; Singh MP. Identification of differentially expressed proteins in striatum of maneb and paraquat - induced Parkinson's disease phenotype in mouse. Neurotoxicol Teratol: 29; 2007; 578-585.
51. Pathak N; Khandelwal S. Cytoprotective and immunomodulating properties of Piperine on murine splenocytes : an in vitro study . Euro J Pharmacol: 576; 2007; 160-170.
52. Pathak N; Khandelwal S. Impact of cadmium in T lymphocyte subsets and cytokine expression: Differential regulation by oxidative stress and apoptosis. Biomet: 21; 2008; 179-187.
53. Pathak SP; Gopal K. Bacterial contamination and antibiotic rsistance in fecal coli form from runoff of Gangotri Glacier. Bull Environ Contam Toxicol: 79; 2007; 163-167.

54. Pathak SP; Gopal K. Enterotoxigenicity of enteric bacteria from various water sources. J Life Sci: 2; 2008; 1 - 9.
55. Pathak SP; Gopal K; Prevalence of bacterial contamination with antibiotic resistant and enterotoxigenic faecal coliforms in treated drinking water. J Toxicol Environ Hlth Part A: 71; 2008; 427-433.
56. Prasad S; Kalra N; Shukla Y. Induction of apoptosis by lupeol and mango extract in mouse prostate and LNCaP cells. Nutri Cancer: 60; 2008; 120-130.
57. Prasad S; Kalra N; Singh M; Shukla Y. Protective effects of lupeol and mango extract against androgen induced oxidative stress in Swiss albino mice. Asian J Androl: 10; 2008; 313-318.
58. Prasad S; Kalra N; Srivastava S; Shukla Y. Regulation of oxidative stress mediated apoptosis by diallyl sulfide in DMBA exposed Swiss albino mice. Hum Exp Toxicol: 27; 2008; 55-63.
59. Prasad S; Kaur J; Roy P; Kalra N; Shukla Y. Theaflavins induces G2/M arrest by modulating expression of p21waf1/cip1, cdc25C and cyclin B in human prostate carcinoma PC-3 cells. Life Sci: 81; 2007; 1323-1331.
60. Rai V; Kakkar P; Singh J; Misra C; Kumar S; Mehrotra S. Toxic metals and organochlorine pesticides residue in single herbal drugs used in important ayurvedic formulation - 'Dashmoola'. Environ Monit Assess: 143; 2008; 273-277.
61. Raj A; Reddy MMK; Chandra R. Identification of low molecular weight aromatic compounds by gas chromatography – mass spectrometry (GC-MS) from kraft lignin degradation by three *Bacillus sp.* Int Biodeterio Biodegrad: 59; 2007; 292-296.
62. Raj A; Reddy MMK; Chandra R; Purohit HJ; Kapley A. Biodegradation of kraft-lignin by Bacillus sp. isolated from paper mill sludge. Biodegrad: 18; 2007; 783 – 792.
63. Ram S; Vajpayee P; Shanker R. Prevalence of multi-drug resistant, shiga toxin and enterotoxin producing *Escherichia coli* in surface waters of river Ganga. Environ Sci Technol: 41; 2007; 7383-7388.
64. Ram S; Vajpayee P; Shanker R. contamination of potable water distribution system by multi-antimicrobial resistant enterohaemorrhagic *Escherichia coli.* Environ Hlth Persp: 116; 2008; 448-452.
65. Rastogi S; Shukla Y; Paul BN; Chaudhury DK; Khanna SK; Das M. Studies on mechanism of protective effect of *Ocimum sanctum* on 3-methylcholantherene, 7,12-dimethylbenzanthracene and aflatoxin B1 induced skin tumorigenesis in mice. Toxicol Appl Pharmacol: 224; 2007; 228-240.
66. Seth CS; Chaturvedi PK; Misra V. Toxic effect of arsenate and cadmium alone and in combination on Giant Duckweed (*Spirodela polyrrhiza L.*) in response to its accumulation. Environ Toxicol: 22; 2007; 539-549.

67. Seth CS; Misra V; Singh RR. Cadmium induced phytochelatin synthesis and its role in heavy metal accumulation, detoxification and metabolisms in Indian mustard (*Brassica juncea L.*). J Ecophysiol Occupat Hlth: 7; 2007; 5-9.
68. Shah PP; Singh AP; Singh M; Mathur N; Buters JTM; Pant MC; Parmar D. Interaction of cytochrome P4501A1 genotypes with other risk factors and susceptibility to lung cancer. Muta Res - FUND MOL M : 639; 2008; 1-10.
69. Shah PP; Singh AP; Singh M; Mathur N; Mishra BN; Pant MC; Parmar D. Association of functionally important polymorphisms in Cytochrome P4501B1 with lung cancer. Mutat Res - FUND MOL M; 643; 2008; 4-10.
70. Sharma S; Misra C; Chandra P; Kakkar P. Microbiological quality and organochlorine pesticide residue in commercially available ready-to-eat raisins. Bull Environ Contam Toxicol: 81; 2008; 387-392.
71. Shrivastava R; Nagar R; Ravishankar GA; Upreti RK; Chaturvedi UC. Effect of pretreatment with chromium picolinate on hematological parameters during dengue virus infection in mice. Ind J Med Res: 126; 2007; 440-446.
72. Shukla PK; Khanna VK; Ali MM; Khan MY; Srimal RC; Anti-ischemic effect of curcumin in rat brain. Neurochem Res: 33(6); 2008; 1036-1043.
73. Shukla UC; Murthy RC; Kakkar P. Combined effect of ultraviolet-B radiation and cadmium contamination on nutrient uptake and photosynthetic pigments in *Brassica campestris L.* seedlings. Environ Toxicol: (doi-10.1002/tox.20378. 2008.03.17); 2008; [Epub ahead of print].
74. Shukla Y. Tea and cancer chemoprevention: A comprehensive review. Asian Pacific J Cancer Preven: 8; 2007; 155-166.
75. Shukla Y; Prasad S; Tripathi C; Singh M; George J; Kalra N. *In vitro* and *in vivo* modulation of testosterone mediated alterations in apoptosis related proteins by [6]-gingerol. Mol Nutri Food Res: 51; 2007; 1492-1502.
76. Siddique HR; Gupta SC; Mitra K; Bajpai VK; Mathur N; Murthy RC; Saxena DK; Chowdhuri DK. Adverse effect of tannery waste leachates in transgenic *Drosophila melanogaster:* Role of ROS in modulation of Hsp70, oxidative stress and apoptosis. J Appl Toxicol: 28; 2008; 734-748.
77. Siddique HR; Sharma A; Gupta SC; Murthy RC; Dhawan A; Saxena DK; Chowdhuri DK. DNA damage induced by industrial solid waste leachates in *Drosophila melanogaster:* A mechanistic approach. Environ Mol Mutagen: 49; 2008; 206-216.
78. Siddiqui IA; Shukla Y; Adhami VM; Sarfaraz S; Asim M; Hafeez BB; Mukhtar H. Suppression of NFkappaB and its Regulated Gene Products by oral administration of Green Tea Polyphenols in an Autochthonous mouse prostate cancer model. Pharmaceut Res: 25; 2008; 2135-2142.

79. Siddiqui MA; Khanna VK; Singh G; Kashyap MP; Yadav S; Chandra D; Pant AB. Influence of cytotoxic doses of 4-hydroxynonenal on selected neurotransmitter receptors in PC12 cells. Toxicol In Vitro : 22; 2008; 1681-1688.
80. Singh AK; Chaudhary P; Macwan AS; Diwedi UN; Kumar A. Selective loss of lin genes from hexachlorocyclohexane-degrading *Pseudomonas aeruginosa* ITRC-5 under different growth conditions. Appl Microbiol Biotechnol: 76; 2007; 895-901.
81. Singh AP; Shah PP; Mathur N; Buters JTM; Pant MC; Parmar D. Genetic polymorphism in Cytochrome P4501B1 and susceptibility to head and neck cancer. Mutat Res - FUND MOL M: 639; 2008; 11-19.
82. Singh C; Ahmad I; Kumar A. Pesticides and metals induced Parkinson's disease: Involvement of free radicals and oxidative stress. Cell Mol Biol: 53; 2007; 19-28.
83. Singh CK; Ojha A; Bhatanagar RK; Kachru DN. Detection and characterization of recombinant DNA expressing vip3A-type insecticidal gene in GMOs—standard, single, multiplex and construct-specific PCR assays. Anal Bioanal Chem: 390; 2008; 377–387.
84. Singh CK; Ojha A; Kachru DN. Detection and characterization of cry1Ac transgene construct in Bt cotton: multiple polymerase chain reaction approach. J AOAC Int: 90; 2007; 1517-1525.
85. Singh CK; Ojha A; Kamle S; Kachru DN. Assessment of cry1Ab transgene cassette in commercial Bt corn MON810: Gene, Event, Construct & GMO specific concurrent characterization. Nature Protocols: 2007; (doi -10.1038/nprot.2007.440). [Epub ahead of print]
86. Singh G; Siddiqui MA; Kashyap MP; Yadav S; Khanna VK; Saxena AK; Gupta YK; Pant AB. Oxygen Glucose deprivation model of cerebral stroke in PC-12 cells: Glucose as a limiting factor. Toxicol Mech Methds: 2008; (In Press).
87. Singh KP; Malik A; Kumar R. Receptor Modeling for source apportionment of PAHs in urban atmosphere. Environ Monit Assess: 136; 2008; 183-196.
88. Singh KP; Malik A; Singh S; Ojha P. Liquid-phase adsorption of phenols using activated carbons derived from agricultural waste material. J Hazard Materials: 150; 2008; 626-641.
89. Singh KP; Malik A; Sinha S; Mohan D; Singh VK. Exploring groundwater hydrochemistry of Alluvial Aquifers using multi-way modeling. Anal Chim Acta: 596; 2007; 171-182.
90. Singh KP; Malik A; Sinha S; Singh VK. Multi-block data modeling for characterization of soil contamination: A case study. Water Air Soil Poll: 185; 2007; 79–93.
91. Singh KP; Singh VK; Malik A; Sharma N; Murthy RC; Kumar R. Hydrochemistry of wet atmospheric precipitation over an urban area in Northern Indo-Gangetic plains.

Environ Monit Assess: 131; 2007; 237-254.

92. Singh M; Khan AJ; Shah PP; Shukla R; Khanna VK; Parmar D. Polymorphism in environment responsive genes and association with Parkinson disease. Mol Cell Biochem: 312; 2008; 131-138.
93. Singh M; Shah PP; Singh AP; Ruwali M; Mathur N; Pant MC; Parmar D. Effect of polymorphic GST genes on susceptibility to oral cancer. Muta Res. Fundamental and Molecular Mutagenesis: 638; 2008; 184-194.
94. Singh S; Bhatta UM; Satyam PV; Dhawan A; Sastry M; Prasad BLV. Bacterial synthesis of silicon/silica nanocomposites. J Mat Chem: 18; 2008; 2601-2606.
95. Singh S; Chandra R; Patel DK; Rai V. Isolation and characterization of novel *Serratia marcescens* (AY927692) for pentachlorophenol degradation from pulp and paper mill waste. World J Microbial Biotechnol: 23; 2007; 1747-1754.
96. Singh S; Chandra R; Patel DK; Reddy MMK; Rai V. Investigation of the biotransformation of pentachlorophenol and pulp paper mill effluent decolorisation by the bacterial strains in a mixed culture. Biores Tech: 99; 2008; 5703-5709.
97. Singh S; Singh K; Patel S; Patel DK; Singh C; Nath C; Singh MP. Nicotine and caffeine-mediated modulation in the expression of toxicant responsive genes and vesicular monoamine transporter-2 in 1-methyl 4-phenyl-1,2,3,6- tetrahydropyridine-induced Parkinson's disease phenotype in mouse. Brain Res: 1207; 2008; 193-206.
98. Singh V; Rastogi N; Mathur N; Singh K; Singh MP. Association of polymorphism in MDM-2 and p53 genes with breast cancer risk in Indian women. Ann Epidemiol: 18; 2008; 48-57.
99. Singh VK, Patel DK, Ram S; Mathur N; Siddiqui MKJ. Blood levels of polycyclic aromatic hydrocarbons in children and their association with oxidative stress indices: An Indian perspective. Clin Biochem: 41; 2008; 152-161.
100. Singh VK; Patel DK; Ram S; Mathur N; Siddiqui MKJ; Behari JR. Blood level of Polycyclic Aromatic Hydrocarbons in children of Lucknow, India. Archives Environ Conta Toxicol: 54; 2008; 348-354; (doi - 10.1007/ s 00244-007-9015-3). [Epub ahead of print]
101. Sinha A; Singh C; Parmar D; Singh MP. Proteomics in clinical interventions: Achievements and limitations in biomarker development. Life Sci: 80; 2007; 1345-1354.
102. Srivastava AK; Mathur N. Occupational disease among migrant labour in traditional brick kilns of India. Asian Pacific Newsletter on Occ H Safety: 14; 2007; 40-42.
103. Srivastava N; Seth K; Srivastava N; Khanna VK; Agrawal AK. Functional restoration using basic fibroblast growth factor (bFGF) infusion in Kainic acid induced cognitive dysfunction in rat: neurobehavioural and neurochemical studies. Neurochem Res: 33; 2008; 1169-1177.

104. Tripathi M; Khanna SK; Das M. Surveillance on use of synthetic colours in eatables vis as vis prevention of food adulteration Act of India. Food Control: 18; 2007; 211-219.
105. Upadhyay G; Kumar A; Singh MP. Effect of silymarin on pyrogallol- and rifampicin-induced hepatotoxicity in mouse. Europ J Pharm: 565; 2007; 190-201.
106. Verma. K; Agrawal N; Misra RB; Farooq M; Hans RK. Phototoxicity assessment of drugs and cosmetic products using *E.coli*. Toxicol in vitro: 24; 2008; 249-253.
107. Yadav N; Khandelwal S. Effect of Picroliv on cadmium induced testicular damage in rat. Food Chem Toxicol: 46; 2008; 494-501.
108. Yadav S; Chandra R. Inhibitory effect of melanoidins, phenols and sulphate present in post methanated distillery effluent (PMDE) for detoxification by *Defluvibacter lusatiae* ITRC PK 1 (DQ 659618). Toxicol Intl: 14: 2007; 171-177.
109. Yadav SS; Ruwali M; Shah PP; Mathur N; Singh RL; Pant MC; Parmar D. Association of poor metabolizers of cytochrome P450 2C19 with Head and Neck cancer and poor treatment response. Mutat Res - FUND MOL M 644; 2008; 31-37.

Chapters in Books

1. Shukla Y; George J; Nigam N. Cancer chemopreventive effects of black tea. Economic Crisis in Tea industry. Stadium Press, LLC, USA: 2008; 286-295.
2. Mandal BB; Srivastava AK. Mechanization, vibration and Indian work force. Mining – social and economic prerspectives. The ICFAI University Press, Hyderabad: 2008; 84-96.
3. Misra V; Pandey SD. Qualntification of total organic carbon (TOC) content in water and wastewater. Water and wastewater (Ed) Gopal K. APH Publication corporation, New Delhi: 99-104.

Publication	Number
Research Papers	109
Book Chapters	03
Average Impact Factor	2.011
Impact factor/scientist	2.884

Staff List as on 31.3.2008

Dr. Ashwani Kumar
Acting Director

Analytical Toxicology
Dr. M.K.J. Siddiqui, Scientist Gr. IV(4) & Head (On lien to CST, U.P.)

Aquatic Toxicology
Dr. Krishna Gopal, Scientist Gr. IV(4) & Head
Dr. S.P. Pathak, Scientist Gr. IV(3)
Dr. (Mrs.) Swarn Lata, Gr. III(6)
Mr. Pyare Lal, Gr. II(3)
Mrs. A.P. John, Gr. II(4)

Biomembrane Toxicology
Dr. R.K. Upreti, Scientist Gr. IV(4) & Head
Dr. A. Kannan, Scientist Gr. IV(3)
Mrs. Mumtaz Jahan, Gr. II(3)

Cardiovascular Toxicology
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Dr. M.D. Rana, Gr. III(6)
Dr. G.S.D. Gupta, Gr. III(6)

Cell Biology
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Dr. L.K.S. Chauhan, Gr. III(6)
Dr. P.N. Saxena, Gr. III(6)
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Dr. K. Ravi Ram, Scientist Gr. IV(2)
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Dr. M.P. Singh, Scientist Gr. IV(2)

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Mr. U.K. Singh, Gr. III (5)
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Dr. G.C. Kisku, Scientist Gr. IV(4)
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Mr. Abhimanyu Singh, Gr. III(6)
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Mr. Ram Bilas, Jr. Stenographer

Herbal Research

Dr. Poonam Kakkar, Scientist Gr. IV(5) & Head
Dr. A.K. Khanna, Scientist Gr. IV(3) (Superannuated on 31.08.2007)
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Mr. J.C. Awasthi, Gr. II(1)

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Dr. A.K. Saxena, Scientist Gr. IV(5) (Superannuated on 30.06.2007)
Dr. B.N. Paul, Scientist Gr. IV(4) & Head
Dr. S.L. Nagle, Scientist Gr. IV(3)
Dr. S.C. Srivastava, Scientist Gr. IV(3)
Mrs. Balbir Kaur, Jr. Stenographer
Mr. B.M. Pandey, Gr. II(1)
Mr. Hari Ram, Gr. I(3)

Immunotoxicology
Dr. (Mrs.) Shashi Khandelwal, Scientist Gr. IV(5) & Head
Dr. Preeti Srivastava, Scientist Gr. IV(2)
Mr. R.S. Verma, Gr. II (4)

Inhalation Toxicology
Dr. R.C. Murthy, Scientist IV(4) & Head
Dr. Kewal Lal, Gr. III(5)
Mr. U. Mani, Gr. III(3)
Mr. Dheer Kumar, Gr. II(3)
Mr. S.L. Yadav, Gr II(1)
Mr. Ram Kumar, Gr. I(4)
Mr. Shiv Pyare, Gr. I(3)

Neurotoxicology
Dr. Vinay Kumar Khanna, Scientist Gr. IV(3) & Head
Dr. Pramod Kumar, Gr. III(5)

Pesticides Toxicology
Dr. R.B. Raizada, Scientist Gr. IV(5) & Head (Superannuated on 31.03.2008)
Dr. L.P. Srivastava, Scientist Gr. IV(4) & Head
Dr. D.K. Agrawal, 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(5)
Mrs. Syamala Das, Gr. II(4)

Petroleum Toxicology
Dr. S.K. Goel, Scientist Gr. IV(4) & Head
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) (Superannauated on 31.07.2007)
Dr. Ratan Singh Ray, Scientist Gr. IV(3)
Dr. Mohd. Farooq, Scientist Gr. IV(3)

Preventive Toxicology
Mr. R.K. Tewari, Gr. II(3) (Superannuated on 31.10.2007)
Mr. Chedi Lal, Gr. I(4)

Toxicokinetics
Dr. Jai Raj Behari, Scientist Gr. IV(5) & Head
Mr. Ramesh Chandra, Gr. III(5)
Mr. Ram Chandra, Gr. II(4)
Mr. Mohd. Aslam, Sr. 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(6)
Ms. Poonam Saxena, Gr. III(5)
Mr. Satgur Prasad, Gr. III(5)
Mr. B.K. Singh, Gr. II(4)
(Superannuated on 31.07.2007)
Mr. Pramod K. Srivastava, Gr II (1)

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(2)
Dr. Pradeep Kumar, Gr. III(5)
Mr. A.S. Prem, Gr. III(3)
Mr. P.K. Singh, Gr. III(2)
Mr. Dan Bahadur, Gr. II(4)
Mr. Swami Nath, Gr. II(4)
Mr. M.L. Kanojia, Gr. II(4)
Mr. Hira Lal, Gr. I(3)
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) (Superannuated on 31-7-2007)
Dr. R.K. Kanojia, Gr. III(3)

Computer Cell
Mr. Nikhil Garg, Scientist Gr. IV(4)
Mr. Umesh Prasad, Gr. II(4) (taken VRS)

Distillation Unit
Dr. Jai Raj Behari, Scientist Gr. IV(5) & Head
Mr. Khalil Ahmed, Gr. II(4)

ENVIS Centre
Dr. (Mrs) F.N. Jaffery, Scientist Gr. IV (2) & Head
Mr. Shailendra Kumar Gupta, Scientist Gr. IV(2)
Dr. (Mrs) Anvita Shaw, Gr. III(5)
Mr. S.H.N. Naqvi, Gr. II(1)

Library & Toxicology Information Centre
Dr. DK Saxena, Scientist Gr. IV(5) (Scientist-in-Charge)
Mrs. Sushma Sharma, Gr. III(7) & Head
Mr. Saaduzzaman, Gr. III(7) (Superannuated on 31-8-2007)
Mr. Arun Kumar, Gr. III(4)
Mrs. Rajni Ahirwar, Gr III (4)
Mrs. M. Joshi, Gr. II(4) (Superannuated on 31.03.2008)
Mr. Girish Chandra, Gr. II(4)
Mr. Surendra Kumar, Gr II(4)
Mr. B.C. Pant, Gr. II(4)
Mr. Mohan Lal, Gr. II(4)
Mr. Ram Bahadur, Gr. II(3) (Expired)
Mr. Dwijendra Upadhyay, Gr II (1)
Mr. Abdul Rahman, Gr II (1)
Mrs. Shanti Devi, Gr. I(4)
Mr. Kallu Prasad, Gr. I(3)

Medical Illustration & Photography
Dr. Kailash Chandra Khulbe, Scientist Gr. IV(3) (Scientist-in-Charge)
Mr. Kishan Lal, Gr II(5)
Mr. M.C. Sharma, Gr. II(4)
Mr. Naushad Ahmad, Gr. I(3)

Quality Assurance Unit
Dr. R.K. Upreti, Quality Manager
Dr. S.K. Bhargava, Alternate Quality Manager (Superannuated on 31.8.2008)
Dr. V.P. Sharma, Technical Operation Manager
Dr. S. Khandelwal, Alternate Technical Operation Manager

Auditors - Biological
Dr. DK Saxena
Dr. Sushil Kumar
Dr. Shashi Khandelwal
Dr. S.K. Gupta (Superannuated on 31.03.2008)

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.K. Jain, Gr. III(6)
Dr. Sikandar Ali, Gr.III (5) (Superannuated on 31.02.2008)
Mr. H.N. Roy, Gr. II(4)
Mr. B.D. Upadhyay, Gr. II(4)
Mr. Laxmi Kant, Gr. II(4)
Mrs. S.L. Sharma, Gr. II(3) (Superannuated on 31-7-2007)
Mr. Budhiram Prasad, Gr. II(2)
Mrs. Shanti, Gr. I(3)

RTI Cell
Dr. DK 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(4)

Infrastructure
Director's Office
Dr. (Mrs.) Chetna Singh, Scientist Gr. IV(2)
Dr. R.B. Misra, Gr. III(6)
Mr. Subedar Ram, PS to Director (Superannuated on 31.07.2007)

Mr. B.K. Jha, Sr. Stenographer
Mr. Narendra Singh, Gr. D (Non-technical)

Administration/Establishment Section

Mr. Tariq Qutubuddin, Sr. Controller of Administration
Mr. Jagannath, Section Officer
Mr. Pradeep Kumar, Section Officer
Mr. Amit Kumar Mishra, Asstt. Gr III
Mr. Vivek Srivastava, Security Officer
Mr. R.A. Gupta, Security Officer (Superannuated on 31.01.2008)
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. II
Mr. S.A. Hasan, Gr. II (1)
Mr. Abhishek Rawat, Gr. II (1)
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)
Mr. Pushp Raj, Asstt. Gr. I
Mr. Amit Kumar, Astt.. Gr. I
Mr. Anant Ram Shukla, Gr. D (Non-technical)

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. Urgrasen, Asstt. Gr. II

Mr. Raja Lal Dubey, Asstt. Gr. II
Mr. Kamta Prasad, Asstt., Gr. II
Mr Anuj Deep, Asstt., Gr. III
Mr. Tanuj Joshi, Jr. Stenographer
Mr. Mohd Ateeq, Gr. D (Non-technical)
Mr. Mahesh Yadav, Gr. D (Non-technical)

Stores & Purchase

Mr. Vinay Kumar, 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, Asstt. Gr. I
Mr. Ramendra Kumar, Asstt. Gr. I
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. Raj Kumar Upadhyay, Gr. III(4)
Mr. A.K. Sinha, Gr. II(4)
Mr. P.S. Shukla, Gr. II(4)
Mr. Tribhuwan Dutt, Gr. II(4)
Mr. Ashok Kumar, Gr. II(4)
Mr. Amar Charan, Gr. II(4)
Mr. Shiv Kumar, Fieldman, Gr. II (4)
Mr. Munsi Lal, Gr. I(4)
Mr. Hira Lal, Gr. I (4)
Mr. Mata Prasad, Gr. I(3)
Mr. Putti Lal, Gr. D (Non-technical)
Mr. Anirudh, Gr. D (Non-technical)

Engineering Unit (Electrical & Mechanical)

Mr. Yogendra Singh, Gr. III(6)
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)

Canteen

Mr. Anoop Kumar, Manager
Mr. Ashok Kumar, Counter Clerk
Mr. Mohan Lal, Halwai
Mr. Mohd Quddus, Asstt. Halwai (Superannuated on 31.08.2007)
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(4)
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)

Superannuation

Name of Staff	Date of Superannuation
Dr A.K. Saxena	30.06.2007
Mrs. Swaran Lata Sharma	31.07.2007
Sri B.K. Singh	31.07.2007
Dr Uma Shanker	31.07.2007
Dr A.K. Agarwal	31.07.2007
Sri G.S. Tandon	31.07.2007
Sri Subedar Ram	31.07.2007
Sri M. Quddus	31.07.2007
Dr A.K. Khanna	31.08.2007
Sri Saduzaman	31.08.2008
Sri R.K. Tewari	31.10.2007
Dr J.S. Gaur	31.01.2008
Sri R.A. Gupta	31.01.2008
Dr Sikandar Ali	31.01.2008
Mr. M. Joshi	31.03.2008
Dr Shrawan Kumar Gupta	31.03.2008
Dr R.B. Raizada	31.03.2008

Promotions

S. No.	Name	Present Group	Group Grade after Promotion	Due date of Promotion
1.	Dr Shashi Khandelwal	IV(4)	IV(5)	01.04.2005
2.	Dr Poonam Kakkar	IV(4)	IV(5)	11.05.2005
3.	Dr Yogeshwer Shukla	IV(4)	IV(5)	01.01.2006
4.	Dr K.P. Singh	IV(4)	IV(5)	01.01.2006
5.	Dr D. Kar Chowdhuri	IV(4)	IV(5)	01.01.2006
6.	Dr Alok Dhawan	IV(3)	IV(4)	04.04.2005
7.	Dr S.C. Barman	IV(3)	IV(4)	30.08.2005
8.	Sri Nikhil Garg	IV(3)	IV(4)	01.01.2006
9.	Dr N. Manickam	IV(3)	IV(4)	31.01.2006
10.	Dr G.C. Kisku	IV(3)	IV(4)	05.02.2006
11.	Dr Dinesh Mohan	IV(1)	IV(2)	06.10.2003
12.	Dr C.B. Pradosh	IV(1)	IV(2)	16.09.2005
13.	Dr L.K.S. Chauhan	III(5)	III(6)	26.09.2006
14.	Dr P.N. Saxena	III(5)	III(6)	26.09.2006
15.	Dr R.B. Mishra	III(5)	III(6)	26.09.2006
16.	Sri Yogendra Singh	III(5)	III(6)	18.10.2005
17.	Dr Pradeep Kumar	III(4)	III(5)	26.09.2006
18.	Sri R.K. Upadhaya	III(3)	III(4)	21.8.2005
19.	Sri Ashok Kumar	II(3)	II(4)	15.10.2006
20.	Sri A.K. Sinha	II(3)	II(4)	15.10.2006
21.	Sri Shiv Kumar	II(3)	II(4)	03.11.2006
22.	Sri B.S. Pandey	II(3)	II(4)	01.03.2007
23.	Sri. R.S. Verma	II(3)	II(4)	01.03.2007
24.	Sri B.D. Upadhaya	II(3)	II(4)	01.03.2007
25.	Sri Lakshmi Kant	II(3)	II(4)	01.03.2007
26.	Smt. A.P. John	II(3)	II(4)	01.03.2007
27.	Sri Umesh Prasad	II(3)	II(4)	26.09.2006

New Appointments

Name	Designation	Date of Joining
Mr Shailendra Kumar Gupta	Gr. IV(2)	April 22, 2007
Mrs Jyotsna Singh	Gr. IV(1)	April 23, 2007
Mr Rajeev Singh	Gr. IV(1)	June 29, 2007
Mrs Preeti Chaturvedi	Gr. IV(1)	July 2, 2007
Dr Sanghamitra Bandyopadhyay	Gr. IV(2)	August 13, 2007
Dr Sanjay Yadav	Gr. IV(1)	August 13, 2007
Dr Preeti Srivastava	Gr. IV(2)	September 6, 2007
Dr Ravi Ram Kristipati	Gr. IV(2)	January 2, 2008
Dr Kausar Mahmood Ansari	Gr. IV(1)	January 31, 2008
Dr B. R. Achyut	Gr. IV(1)	February 29, 2008

Staff Strength

Scientific Group IV	76
Technical Group III	37
Technical Group II	62
Technical Group I	17
Administration A	03
Administration B	29
Administration C	20
Administration D	17
	Total 261

EXTERNAL CASH FLOW (ECF) * generated during 2007-2008	
Govt. Department	317.799
Industries	26.253
Foreign	40.939
Lab Reserves Generated	109.506
Total	**494.497**

Government budget * during 2007-2008	
Plan	11.76.407
Non Plan	773.677
Total	**1950.084**

* Rs in lakhs