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हिन्दी भाषा खण्ड

*CSIR- Indian Institute of Toxicology Research*  
*(Council of Scientific and Industrial Research)*  
*Lucknow, India*



## EVENTS

### National Science Day

Indian Institute of Toxicology Research (IITR), Lucknow celebrated National Science Day on 28th February, 2011. Dr. Mukul Das, Scientist 'G' and Chairman National Science Day Committee welcomed the chief guest Prof. Ram Rajasekharan, Director, Central Institute of Medicinal & Aromatic Plants, Lucknow and the children of various schools attending the function. He said that celebration of the day offers an opportunity to bring issues of science in the centre stage and create public awareness about such issues. He also said that IITR has specially invited the children on this day so that our scientists can ignite the minds of the students and inculcate a scientific temper in them. On this occasion a publication in Hindi entitled "Vish Vigyan Sandesh" was released by Prof. Rajasekharan. Earlier Prof. Rajasekharan inaugurated an exhibition depicting a few activities of the institute through exhibits. The major exhibits were:

1. Demonstration of colour detection kit (CD-strip), developed by IITR for the detection of a non-permitted, carcinogenic oil soluble dye, butter yellow in mustard oil. Food stuffs coloured with various permitted and non permitted colours were displayed and the students were made aware of the possible health risk associated with these colours.
2. The criteria involved in safety evaluation of plastic and polymeric materials and biosafety assessment studies of plastic and polymeric products was explained to the visitors.
3. Noise level monitor for recording of noise levels,

air quality monitor for CO, CO(2), PM, Temp. and RH; fine particulate sampler for PM 2.5, respirable dust sampler for monitoring of air pollutants namely, SPM, RSPM, SO(2) and NO(x) was demonstrated.

4. Portable water analysis kit for chemical and bacteriological analysis of water samples was demonstrated.
5. Herbal products were demonstrated which have shown hepatoprotective, anti-diabetic and anti-asthmatic activity.
6. Body fat examination using impedance analysis was performed for the school children. The examination included determination of body mass index as per WHO guidelines (1995). Body fat percent and visceral fat level (related to abdominal obesity) was determined using Japan Society for Study of Obesity (2002) recommendations.

Prof. Ram Rajasekharan delivered a lecture on "Lipids in food and health". He dwelt on various types of fats - unsaturated, saturated and trans fats. He further said that people eat junk food which contain trans fats and such fats are not good for health. He said that his organization is working on a project to manipulate the genes of a specific plant that can synthesize different food components such as oil, protein and carbohydrate and also increase their yield in the plant. He also highlighted the application of science in day to day life and urged the students to take up science as a career. Dr. Devendra Parmar, Scientist and Convener of the programme proposed the vote of thanks.



"Vish Vigyan Sandesh" was released by Prof. Rajasekharan



Visit of the guests during science exhibition

World Environment Day was celebrated at Indian Institute of Toxicology Research (IITR), Lucknow on June 5, 2011. On this occasion Prof. Kasturi Datta, DBT Distinguished Biotechnology Research Professor & Adjunct Professor, Special Centre for Molecular Medicine, School of Environmental Science Jawaharlal Nehru University, New Delhi-110067 delivered Dr C.R. Krishna Murti Memorial Oration and Prof. D.K. Gupta, Vice Chancellor, Chatrapati Shahuji Maharaj Medical University, Lucknow presided over the function. Dr K.C. Gupta, Director, IITR welcomed the guest and elaborated the history of World Environment Day celebrations as well as theme of this year's World Environment Day: Forests: Nature At Your Service. He told that India has the largest Green Energy project in the world. The Pre-monsoon Environmental Status Report, prepared by institute was released by Prof. Kasturi Datta.

Dr Mukul Das gave the genesis of Dr C.R. Krishna Murti Memorial Oration and also introduced Prof. Kasturi Datta. In her oration entitled "Hyaluronan Binding Protein 1: A Molecular Switch in Cancer Progression" Prof. Datta described the role of extracellular matrix (ECM) organization in tissue remodeling during the cancer progression is well accepted in recent years. She told that they are working for the last few years to understand the molecular basis of involvement of ECM proteins in cell-cell interaction, signal transduction and apoptosis induction in transformed cells. Their work initiates with identification and purification of a novel cell surface glycoprotein named as human Hyaluronan Binding Protein 1 (HABP1), which binds specifically to hyaluronic acid (HA), a ubiquitous complex glycosaminoglycan of ECM and has been shown to be involved in cellular differentiation and various physio-pathological conditions. In order to elucidate its precise role, the gene encoding human Hyaluronan Binding Protein 1 has been cloned by immunoscreening the human fibroblast expression library and overexpressed in different expression systems and is reported to be localized on human chromosome 17p13.3. Sequence analysis by laboratory further highlights the multifunctional nature of this protein as its sequence is identical with the receptor of globular head of C1q (the complement protein) and with p32, a protein co-purified with splicing factor SF2, whose function was unknown. The Human Genome Project recognized this work internationally and the name HABP1 is assigned as a synonym of gC1qR/ p32 in the genome map. In order to determine the biological function of HABP1, their group followed the approach of functional genomics in studying

its specific expression, structure-function relationship, genomic analysis and genetic manipulations of its constitutive expression. Overexpression of HABP1 in fibroblast and cervix cancer cells leads to growth inhibition, mitochondrial dysfunction with generation of excess ROS and apoptosis induction. However, if it is overexpressed in hepatic carcinoma, ROS insensitive cells, it does not induce apoptosis, rather stimulates cell proliferation through enhanced HA synthesis as visualized by formation of 'HA cable' structures which leads to increased tumorigenic potential. Also exogenous HABP1 induces melanoma cell migration, another hallmark of cancer progression and regulates tumor growth by NF Kappa dependent matrix metalloprotease activation through the interaction of integrin  $\alpha 5 \beta 1$ . Along with these data, reports from Prof. Datta's group and others confirmed the differential expression of intracellular and cell surface HABP1 in skin papilloma, carcinoma and breast cancer tissues suggested its role in cancer progression and its probable use as diagnostic marker.

Prof. D.K. Gupta, while delivering presidential address emphasized that our aim should always be to help the sufferings of human being. The results of all the research work should provide service to the people. He described about the changes in various diagnostic techniques due to advancement in research. He said that we may have to make ourselves aware of environmental conditions pertaining to pollutants and contaminants.

A poster-painting competition was organized on June 1, 2011, Prof. D.K. Gupta awarded the trophies and certificates to the winners of the competition. Mr. A.H. Khan, proposed the vote of thanks.



Director presenting memento to the speaker Prof. Kasturi Datta

## EVENTS



Painting completion for the children on the occasion of World Environment Day



Winners of the painting competition with (L-R) Dr Mukul Das, Prof. Kasturi Datta, Prof. D.K. Gupta, Dr K.C. Gupta and Mr. A.H. Khan

## IITR RESEARCH HIGHLIGHTS

### Usage pattern of synthetic food colours in different states of India and exposure assessment through commodities preferentially consumed by children.

[Dixit S, Purshottam SK, Khanna SK, Das M. Food Addit Contam Part A Chem Anal Control Expo Risk Assess. 2011 Aug;28(8):996-1005. Epub 2011 Jun 22.]

Exposure studies in children are emphasized nowadays given children's higher consumption vulnerability. The present study generated national-level data covering 16 major states of India on the usage pattern of colours and it identified food commodities through which a particular colour has the scope to exceed ADI limits. Out of the total analysed samples, 87.8% contained permitted colours, of which only 48% adhered to the prescribed limit of 100 mg kg<sup>-1</sup>.

The majority of candyfloss, sugar toys, beverages, mouth fresheners, ice candy and bakery product samples exceeded the prescribed limit. Non-permitted colours were mostly prevalent in candyfloss and sugar toy samples. Though sunset yellow FCF (SSYFCF) and tartrazine were the two most popular colours, many samples used a blend of two or more colours. The blend of SSYFCF and tartrazine exceeded the prescribed limit by a factor of 37 in one sample, and the median and 95th percentile levels of this blend were 4.5- and 25.7-fold, respectively. The exposure assessment showed that the intake of erythrosine exceeded the ADI limits by two to six times at average levels of detected colours, whereas at the 95th percentile level both SSYFCF and erythrosine exceeded the respective ADI limits by three- to 12-fold in

all five age groups. Thus, the uniform prescribed limit of synthetic colours at 100 mg kg<sup>-1</sup> under Indian rules needs to be reviewed and should be governed by consumption profiles of the food commodities to check the unnecessary exposure of excessive colours to those vulnerable in the population that may pose a health risk.

### Zinc oxide nanoparticle induced genotoxicity in primary human epidermal keratinocytes.

[Sharma V, Singh SK, Anderson D, Tobin DJ, Dhawan A. J Nanosci Nanotechnol. 2011 May;11(5):3782-8.]

Zinc oxide (ZnO) nanoparticles are widely used in cosmetics and sunscreens. Human epidermal keratinocytes may serve as the first portal of entry for these nanoparticles either directly through topically applied cosmetics or indirectly through any breaches in the skin integrity. Therefore, the objective of the present study was to assess the biological interactions of ZnO nanoparticles in primary human epidermal keratinocytes (HEK) as they are the most abundant cell type in the human epidermis. Cellular uptake of nanoparticles was investigated by scanning electron microscopy using back scattered electrons imaging as well as transmission electron microscopy. The electron microscopy revealed the internalization of ZnO nanoparticles in primary HEK after 6 h exposure at 14 microg/ml concentration. ZnO nanoparticles exhibited a time (6-24 h) as well as concentration (8-20 microg/ml) dependent inhibition of mitochondrial activity as evident by the MTT assay. A significant ( $p < 0.05$ ) induction in DNA damage was observed in cells exposed to ZnO nanoparticles for 6 h at 8

and 14 microg/ml concentrations compared to control as evident in the Comet assay. This is the first study providing information on biological interactions of ZnO nanoparticles with primary human epidermal keratinocytes. Our findings demonstrate that ZnO nanoparticles are internalized by the human epidermal keratinocytes and elicit a cytotoxic and genotoxic response. Therefore, caution should be taken while using consumer products containing nanoparticles as any perturbation in the skin barrier could expose the underlying cells to nanoparticles.

### Tea polyphenols induce apoptosis through mitochondrial pathway and by inhibiting nuclear factor-kappaB and Akt activation in human cervical cancer cells.

[Singh M, Singh R, Bhui K, Tyagi S, Mahmood Z, Shukla Y. *Oncol Res.* 2011;19(6):245-57.]

Phytochemicals present in tea, particularly polyphenols, have anticancer properties against several cancer types. However, studies elucidating the role and the mechanism(s) of action of tea polyphenols in cervical cancer are sparse. In this study, we investigated the mechanism of antiproliferative and apoptotic actions exerted by tea polyphenols on human papilloma virus-18-positive HeLa cervical cancer cells. Treatment of green tea polyphenol (-)-epigallocatechin gallate (EGCG) and black tea polyphenol theaflavins (TF) in HeLa cells showed a marked concentration- and time-dependent inhibition of proliferation and induced sub-G1 phase in a dose-dependent manner after 24 h. There was an attenuation of mitochondrial membrane potential with the increase of reactive oxygen species generation, p53 expression, Bax/Bcl-2 ratio, cytochrome-c release, and cleavage of procaspase-3 and -9 and poly(ADP-ribose)-polymerase, indicating the participation of a mitochondria related mechanism. In addition, EGCG as well as TF inhibited activation of Akt and nuclear factor-kappaB (NF-kappaB) via blocking phosphorylation and subsequent degradation of inhibitor of kappaBalpha and kappaBbeta subunits, thereby downregulating cyclooxygenase-2. Additionally, the protein level of cyclin D1, a transcriptional target of NF-kappaB, was also reduced significantly. Thus, we can conclude that tea polyphenols inhibit the growth of cervical cancer cells by inducing apoptosis and regulating NF-kappaB and Akt.

### Multiple approaches to evaluate the toxicity of the biomass fuel cow dung (kanda) smoke.

[Lal K, Mani U, Pandey R, Singh N, Singh AK, Patel DK, Singh MP, Murthy RC. *Ecotoxicol Environ Saf.* 2011 Jun 28. doi:10.1016/j.ecoenv.2011.06.006 [Epub ahead of print]]

Cow dung (Kanda) is a major source of energy in rural and urban population of developing countries and is burnt in traditional open stoves in confined space of kitchen without proper ventilation. In epidemiological studies, biomass fuel smoke has been reported to be responsible for several respiratory disorders in exposed population. In a laboratory experiment, female wistar rats were exposed to kanda smoke for 60min/day over a period of 12 weeks. Chemical analysis of smoke showed the presence of PAHs. The increase in CYP1A1, GST-ya, GST-yc expression was found in 12 week exposed lung tissues as compared with controls. The exposure to smoke resulted in significant alteration in the BALF cells in the form of clustering of alveolar macrophages and giant cell formation with vacuolated cytoplasm. The macrophages also showed thickness and villi like projections on the cell surface thus reducing their phagocytic activities. Histopathological changes in lung tissue were manifested in the form of damage to bronchiolar epithelium, edema and thickening of alveolar septa and emphysema after 4 and 8 week of exposure. These findings suggest that exposure to kanda smoke increases pulmonary tissue damage and may result in various forms of respiratory infections in the exposed population.

### Modeling and optimization of trihalomethanes formation potential of surface water (a drinking water source) using Box-Behnken design.

[Singh KP, Rai P, Pandey P, Sinha S. *Environ Sci Pollut Res Int.* 2011 Jun 22. DOI: 10.1007/s11356-011-0544-y [Epub ahead of print]]

The present research aims to investigate the individual and interactive effects of chlorine dose/dissolved organic carbon ratio, pH, temperature, bromide concentration, and reaction time on trihalomethanes (THMs) formation in surface water (a drinking water source) during disinfection by chlorination in a prototype laboratory-scale simulation and to develop a model for the prediction and optimization of THMs levels in chlorinated water for their effective control. A five-factor Box-Behnken experimental design combined with response surface and optimization modeling was used for predicting the THMs levels in chlorinated water. The adequacy of the selected model and statistical significance of the regression coefficients, independent variables, and their interactions were tested by the analysis of variance and t test statistics. The THMs levels predicted by the model were very close to the experimental values ( $R^2=0.95$ ). Optimization modeling predicted maximum (192 µg/l) THMs formation (highest risk) level in water during chlorination was very close to the experimental value ( $186.8 \pm 1.72 \mu\text{g/l}$ ) determined in laboratory experiments. The pH of water followed by reaction time and temperature were the most significant factors that affect the THMs formation during chlorination.

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The developed model can be used to determine the optimum characteristics of raw water and chlorination conditions for maintaining the THMs levels within the safe limit.

### Validation and application of *Drosophila melanogaster* as an in vivo model for the detection of double strand breaks by neutral Comet assay.

[Sharma A, Shukla AK, Mishra M, Chowdhuri DK. Mutat Res. 2011 Apr 3;721(2):142-6.]

Comet assay under neutral conditions allows detection of DNA double-strand breaks (DSBs), which has consequence to genome instability and carcinogenesis. The present study aims to validate the neutral Comet assay for genotoxicity assessment in *Drosophila melanogaster* (Oregon R(+)) with three well known DSBs inducers i.e. cyclophosphamide (CP), bleomycin (BLM), cisplatin (CPT) and subsequently its efficacy in detecting DSBs in the organism exposed to a well known environmental chemical, chromium [Cr(VI)]. Third instar larvae of *D. melanogaster* were fed different concentrations of BLM, CPT and CP (50.0-200.0µg/ml) or Cr(VI) (5.0-20.0µg/ml) mixed standard *Drosophila* food for 48h. Neutral Comet assay was performed in cells of mid gut and brain from control and treated larvae. Our results show a dose-dependent increase in the migration of DNA in cells of the exposed organisms. A comparison among DNA lesions per mole number of the test chemical in the exposed groups showed that both BLM and CPT induce more DSBs than CP. Interestingly, Cr(VI) at 20.0µg/ml was found to induce significantly increased ( $p < 0.001$ ) DSBs in the exposed organism as compared to the control. The study while validating neutral Comet assay in *D. melanogaster* suggests its use for in vivo assessment of environmental chemical induced DSBs.

### Transcriptome analysis provides insights for understanding the adverse effects of endosulfan in *Drosophila melanogaster*.

[Sharma A, Mishra M, Ram KR, Kumar R, Abdin MZ, Chowdhuri DK. Chemosphere. 2011 Jan;82(3):370-6.]

Indiscriminate use of agrochemicals worldwide, particularly, persistent organic pollutants (POPs), is of concern. Endosulfan, a POP, is used by various developing/developed nations and is known to adversely affect the development and the hormonal profiles of humans and animals. However, little is known about the molecular players/pathways underlying the adverse effects of endosulfan. We therefore analyzed the global gene expression changes and subsequent adverse effects of endosulfan using *Drosophila*. We used *Drosophila melanogaster* keeping in view of its well

annotated genome and the wealth of genetic/molecular reagents available for this model organism. We exposed third instar larvae of *D. melanogaster* to endosulfan (2.0 µg mL<sup>-1</sup>) for 24 h and using microarray, we identified differential expression of 256 genes in exposed organisms compared to controls. These genes are associated with cellular processes such as development, stress and immune response and metabolism. Microarray results were validated through quantitative PCR and biochemical assay on a subset of genes/proteins. Taking cues from microarray data, we analyzed the effect of endosulfan on development, emergence and survival of the organism. In exposed organisms, we observed deformities in hind-legs, reminiscent of those observed in higher organisms exposed to endosulfan. In addition, we observed delayed and/or reduced emergence in exposed organisms when compared to their respective controls. Together, our studies not only highlight the adverse effects of endosulfan on the organism but also provide an insight into the possible genetic perturbations underlying these effects, which might have potential implications to higher organisms.

### Cholinesterase levels and morbidity in pesticide sprayers in North India.

[Pathak MK, Fareed M, Bihari V, Mathur N, Srivastava AK, Kuddus M, Nair KC. Occup Med (Lond). 2011 Jun 17. doi:10.1093/occmed/064 [Epub ahead of print]]

Pesticide sprayers in North India use different application methods for different crops. To compare cholinesterase activity and symptoms in knapsack and tractor-mounted pesticide sprayers blood cholinesterase activity and symptoms were recorded for 42 knapsack and 66 tractor-mounted sprayers attending a health camp in North India in 2009 and for 30 controls. One hundred and eight of 197 (55%) eligible sprayers consented to participate. Mean acetylcholinesterase (AChE) and butyrylcholinesterase activity was 33 and 60% lower, respectively, in knapsack sprayers than in controls ( $P < 0.001$ ) and 56 and 62% lower, respectively, in tractor-mounted sprayers than in controls ( $P < 0.001$ ). AChE depletion was greater in tractor-mounted sprayers than in knapsack sprayers ( $P < 0.001$ ). In knapsack sprayers compared to controls, odds ratios (OR) were significantly raised for musculoskeletal symptoms (OR 3.9, 95% CI 1.03-18) but not for other symptoms. In tractor-mounted sprayers compared to controls, ORs were significantly raised for neurological (OR 7, 95% CI 2-23), ocular (OR 8.7, 95% CI 2.7-32), respiratory (OR 5.14, 95% CI 1-29), cardiovascular (OR 7.5, 95% CI 2-42), gastrointestinal (OR 5.43, 95% CI 2-18) and musculoskeletal (OR 6.12, 95% CI 2-26) symptoms but not for dermal symptoms (OR 1.93, 95% CI 0.3-20). The risk of cholinesterase inhibition and symptoms is greater in tractor-mounted than in knapsack pesticide sprayers and in both groups compared to controls.

Occupational exposure in pesticide sprayers in North India needs better control, perhaps through redesign of spraying equipment.

### **Production of ROS by Photosensitized Anthracene Under Sunlight and UV-R at Ambient Environmental Intensities.**

[Mujtaba SF, Dwivedi A, Mudiam MK, Ali D, Yadav N, Ray RS. Photochem Photobiol. 2011 Jun 14. doi: 10.1111/j.1751-1097.2011.00955.x. [Epub ahead of print]]

The aim of this study was to analyze the photostability and phototoxicity mechanism of anthracene (ANT) in a human skin epidermal cell line (HaCaT) at ambient environmental intensities of sunlight/UV-R (UV-A and UV-B). Photomodification of ANT under sunlight/UV-R exposure produced two photoproducts, anthrone and 9,10 anthracenedione. Generation of (1) O(2), O(2) (-) and (.) OH was measured under UV-R/sunlight exposure. Involvement of reactive oxygen species (ROS) was further substantiated by their quenching with free radical quenchers. Photodegradation of 2-deoxyguanosine and linoleic acid peroxidation showed that ROS were mainly responsible for ANT phototoxicity. ANT generates significant amount of intracellular ROS in cell line. Maximum cell viability (85%) was reduced under sunlight exposure (30 min). Results of MTT assay accord NRU assay. ANT (0.01 µg mL(-1)) induced cell-cycle arrest at G1 phase. RT-PCR demonstrated constitutive inducible mRNA expression of CYP 1A1 and 1B1 genes. Photosensitive ANT upregulates CYP 1A1 (2.2-folds) and 1B1 (4.1-folds) genes. Thus, the study suggests that ROS and DNA damage were mainly responsible for ANT phototoxicity. ANT exposure may be deleterious to human health at ambient environmental intensities reaching the earth's surface through sunlight.

### **Interplay of early biochemical manifestations by cadmium insult in sertoli-germ coculture: An *in vitro* study.**

[Khanna S, Lakhera PC, Khandelwal S. Toxicology. 2011 Sep 5;287(1-3):46-53. doi:10.1016/j.tox.2011.05.013 Epub 2011 May 30]

Cadmium is a common environmental and occupational hazard and its adverse effect on reproductive organ has been well documented. The present study is planned to delineate the mechanism of Cd toxicity in rat testes. The study shows that Cd causes apoptosis in sertoli-germ cells which is governed by oxidative stress. The authors assayed ROS, GSH and MMP to ensure the role of oxidative stress, further confirmed it by thiol modulators. The initial biochemical response shown in sertoli-germ cells was a significant rise in intracellular calcium followed by a drastic fall in MMP and then ROS generation. The

downstream events included cytochrome c release leading to caspase-3 activation and culminating in cell death via apoptosis. Furthermore Cd disrupted the spermatogenic pathway as evident by suppression in tesmin and LDH-X levels.

### **Association of functionally important polymorphism of microsomal epoxide hydrolase gene (EPHX1) with lung cancer susceptibility.**

[Tilak AR, Kumar S, Jain M, Pant MC, Das BC, Guleria R, Mittal B, Mathur N, Kumar A. Cancer Invest. 2011 Jul;29(6):411-8.

Distribution and gene-environment interaction of EPHX1 polymorphism was evaluated in 175 lung cancer patients and 322 controls from north India. Two novel non-synonymous, Lys117Arg and Leu263Phe, and twelve single nucleotide polymorphisms were identified in the present study. Binary logistic regression analysis showed association of polymorphism Tyr113His with increased risk of lung cancer (OR = 2.2, 95% CI = 1.2-4.0, p < .05). Gene-environment interaction revealed that patients with His113His and smoking habit had significantly greater risk of lung cancer (OR = 4.52, 95% CI = 0.93-43.05, p < .05). Present study provided evidence that EPHX1 polymorphism is associated with lung cancer susceptibility in Indian population.

### **A flow cytometric method to assess nanoparticle uptake in bacteria.**

[Kumar A, Pandey AK, Singh SS, Shanker R, Dhawan A. Cytometry A. 2011 Sep;79A(9):707-12. doi: 10.1002/cyto.a.21085. Epub 2011 Jun 2.]

Toxicity of engineered nanomaterials (ENMs), such as metal oxides, has been of concern among environmental and health scientists. For ecotoxicity studies of ENMs, it is important to assess nanoparticle uptake and correlate it with the cellular response. However, due to nonavailability of adequate methods for assessing cellular uptake of ENMs, there is a lack of information in this important area. In the present study, a method has been developed using flow cytometry, which allows for rapid detection of ENM internalization in live bacteria under different experimental conditions for several generations. Our data demonstrate significant internalization of Zinc oxide (ZnO) and Titanium (IV) oxide (TiO<sub>2</sub>) nanoparticles (NPs) in Escherichia coli in a dose-dependent manner. ZnO NPs treatment exhibited a significant increase in the intensity of side scatter (SSC) with liver-S9 fraction (76, 94, and 181% increase) rather than without S9 (10.5, 24.5, and 125.9% increase) at 10, 40, and 80 µg/ml concentrations, respectively. This was due to the protein coating of NPs by the S9 fraction. A similar response was also observed on exposure to TiO<sub>2</sub> NPs (139 and 203% with S9 and 128

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and 198% without S9). In a multigeneration study, this new method was able to detect the presence of ENMs in *E. coli* up to four generations. Our data demonstrate that this method can be used for assessing the uptake of ENMs in bacteria and provides a handle to toxicologists for ecotoxicity studies of economically important ENMs to ensure safer products in the market.

### Carryover of cigarette smoke effects on hematopoietic cytokines to F(1) mouse litters.

Shukla M, Kumar P, Mishra V, Chaudhari BP, Munjal AK, Tripathi SS, Raisuddin S, Paul BN. *Mol Immunol.* 2011 Sep; 48(15-16): 1809-1817 doi:10.1016/j.molimm.2011.05.012 Epub 2011 Jun1]

Neutrophils have been implicated in the pathogenesis of COPD, being recruited into the lung in response to cigarette smoke (CS) inhalation and responsible for the release of proteases and oxidant-producing enzymes, resulting in bronchitis and emphysema. Several hematopoietic cytokines are involved in neutrophil growth and recruitment; however, little is known about the effects of CS on hematopoietic cytokines are transmitted between generations. In the present investigation we evaluate the expression of hematopoietic and proinflammatory cytokines in different organs of female F(0) mice subjected to sub-chronic CS exposure, and in F(1) litters. Virgin female Balb/c mice inhaled either air or air containing CS for 90 days. The specific resistance of the airways (sRaw) was evaluated and, thereafter, the mice were mated with unexposed adult males. The levels of granulocyte-macrophage colony stimulating factor (GM-CSF), granulocyte-colony stimulating factor (G-CSF), interleukin-6 (IL-6), IL-1 and TNF- mRNA and protein were evaluated in the bone marrow, amniotic fluid and bronchoalveolar lavage fluid (BALF) of F(0) dams at gestation day(14) (gd(14)) and the bone marrow, BALF and lungs of F(0) dams and F(1) littermates at post natal day(21) (pnd(21)). At gd(14), overexpression of GM-CSF, G-CSF and IL-6 mRNA and protein was observed in the bone marrow, amniotic fluid and BALF of F(0) dams. These hematopoietic cytokines were also overexpressed in the lungs of F(1) littermates compared with the control F(1) litters at pnd(21). Lineage-specific hematopoietic growth factors may play an important role in the transmission of neutrophil-associated disease susceptibility across generations.

### Potential allergens of green gram (*Vigna radiata* L. Millsp) identified as members of cupin superfamily and seed albumin.

[Misra A, Kumar R, Mishra V, Chaudhari BP, Raisuddin S, Das M, Dwivedi PD. *Clin Exp Allergy.* 2011 Aug;41(8):1157-68. doi: 10.1111/j.1365-

2222.2011.03780.x. Epub 2011 Jun 1.]

No systematic study on allergenicity of green gram seed proteins have been performed so far, although incidences of IgE-mediated reaction to green gram seedlings have been reported. We sought to investigate the allergenic potential of green gram, followed by identification and characterization of its relevant allergens using proteomic approaches. Methods BALB/c mice were sensitized intraperitoneally with green gram proteins, and levels of specific Igs, Th2 cytokines, histamine, anaphylactic symptoms and histopathological responses were studied. Twelve naso-bronchial allergic patients with a history of sensitization to green gram were selected on the basis of positive skin prick test and elevated specific IgE levels. Green gram allergens were identified and characterized by their ability to endure pepsin, by IgE immunoblot of two-dimensional (2D) gels in combination with mass spectrometry and by bioinformatics approaches. Results Increased specific IgE, IgG1, Th2 cytokine and histamine levels, high anaphylactic scores and histological changes in lungs and spleen of green gram crude protein extract-treated mice are indicative of its sensitization ability. Four proteins (molecular weights: 52, 50, 30 and 18 kDa) showed pepsin resistance and IgE-binding capability with sensitized human and mice sera. The four proteins tentatively named as Vig r2 (52 kDa, pl 5.7), Vig r3 (50 kDa, pl 5.8), Vig r4 (30 kDa, pl 6.6) and Vig r5 (18 kDa, pl 5.5) showed significant sequence similarity with known allergens of soybean, lentil, pea, lupin, etc. Mass spectrometric analysis identified Vig r2 as 8S globulin -isoform precursor, Vig r3 as 8S globulin -isoform precursor and Vig r4 as seed albumin. Green gram seeds contain at least four clinically relevant allergenic proteins, namely Vig r2, Vig r3, Vig r4 and Vig r5 that were capable of inducing strong IgE-mediated reactions. One of the most important steps towards diagnostic and therapeutic approaches to deal effectively with food allergy is continued identification of newer food allergens and their characterization. The significance of this study can be enormous as the data generated may work as basic biology data in developing a green gram species modified genetically that may have reduced allergenicity.

### UVB-induced apoptosis and DNA damaging potential of chrysene via reactive oxygen species in human keratinocytes.

[Ali D, Verma A, Mujtaba F, Dwivedi A, Hans RK, Ray RS. *Toxicol Lett.* 2011 Jul 28;204(2-3):199-207. Epub 2011 May 6.]

Chrysene is one of the basic polycyclic aromatic hydrocarbon (PAH) which is toxic environmental pollutant and consistently exposed to sunlight. However, little information is available on its photogenotoxicity. The



objective of the present study was to analyze the effects of chrysene, under environmental intensity of UVB (0.6mW/cm<sup>2</sup>) in human skin epidermal cell line (HaCaT). Kinetic of chrysene showed that the highest intracellular uptake of chrysene occurred after 24h of incubation. The intracellular reactive oxygen species (ROS) was increased in a concentration dependent manner in chrysene treated cells under UVB irradiation. It was observed that UVB-irradiated chrysene induced apoptosis through activation of caspases-3 and phosphatidylserine translocation. Glutathione reduced (GSH) and catalase activity were decreased while apoptosis and DNA damage were induced significantly ( $P>0.01$ ) as concentration of chrysene increased. Thus our results suggest that chrysene may be phototoxic as well as photogenotoxic under UVB irradiation.

### **Abrogation of nimesulide induced oxidative stress and mitochondria mediated apoptosis by *Fumaria parviflora* Lam. extract.**

[Tripathi M, Singh BK, Raisuddin S, Kakkar P. J Ethnopharmacol. 2011 Jun 14;136(1):94-102.]

*Fumaria parviflora* Lam. is used for treating aches and pains, diarrhea, fever, influenza and other complications. The herb mixed with honey is taken to prevent vomiting as per Ayurvedic text. *In vivo* studies were conducted to explore the hepatoprotective potential of *Fumaria parviflora* Lam. Fp extract against nimesulide induced oxidative stress and regulation of critical events in mitochondria mediated apoptosis. Group of Wistar rats were fed with nimesulide for 5 days (80 mg/kg/day, po), another group was pre-treated with Fp extract/silymarin (200mg/kg/day, po) for 5 days followed by nimesulide exposure. Liver serum biomarkers and histopathology were done to assess hepatotoxicity caused by nimesulide. Antioxidant enzymes (SOD, LPO, GPx, GR) were assessed using biochemical assays as well as gene expression by RT-PCR. GSH content and ROS generation was also evaluated using flow cytometry. Key apoptotic markers like phosphatidyl serine externalization, Bax, Bcl-2 translocation, mitochondrial membrane potential, cytochrome c release, caspases (9/3) activation and DNA damage were also observed in all the groups to confirm involvement of mitochondrial pathway.

Pre-treatment with Fp extract for 5 days significantly reduced the impact of nimesulide induced toxicity as evident from the serum biomarkers of liver damage and histopathology. It also modulated antioxidant enzymes mRNA expression as well as activity (SOD, glutathione peroxidase, glutathione reductase) and reduced lipid peroxidation during nimesulide toxicity. Nimesulide exposure decreased GSH content (92.9%) and increased

reactive oxygen species (9.29 fold) which was attenuated in Fp treated rats. Fp pre-treatment significantly altered key apoptotic events like Bcl2 and Bax translocation, inhibited mitochondrial depolarization, prevented cytochrome c release, caspase-9/caspase-3 activation and DNA damage. Our *in vivo* findings regarding protection accorded by Fp extract against nimesulide toxicity suggest that Fp not only reduced hepatotoxicity but attenuated critical control points of apoptotic cell death.

### **Impaired cholinergic mechanisms following exposure to monocrotophos in young rats.**

[Sankhwar ML, Yadav RS, Shukla RK, Pant AB, Singh D, Parmar D, Khanna VK. Hum Exp Toxicol. 2011 Apr 20. doi: 10.1177/0960327111405860 [Epub ahead of print]]

Studies on the neurobehavioral toxicity of monocrotophos, an organophosphate, have been carried out on rats following their exposure from postnatal day (PD) 22 to PD 49 to investigate whether neurobehavioral changes are transient or persistent. Exposure of rats to monocrotophos (0.50 or 1.0 mg/kg body weight, p.o.) decreased body weight (10% and 30%) and impaired grip strength (28% and 32%) and learning ability (65% and 68%) at both the doses, respectively in comparison to controls. A trend of recovery was observed in body weight and learning, while decrease in grip strength persisted in rats 15 days after withdrawal. Activity of acetylcholinesterase was decreased in frontal cortex (36% and 67%), hippocampus (21% and 49%) and cerebellum (29% and 51%) in monocrotophos-treated rats at both the doses. The decrease in the activity of acetylcholinesterase persisted in frontal cortex and hippocampus; however, a trend of recovery was observed in cerebellum 15 days after withdrawal. Binding of (3)H-quinuclidinyl benzilate ((3)H-QNB) to frontocortical (19% and 35%), hippocampal (32% and 39%) and cerebellar (19% and 28%) membranes was decreased in monocrotophos-treated rats compared to controls. The decrease in the binding of (3)H-QNB persisted in frontocortical, hippocampal and cerebellar membranes 15 days after withdrawal. The results suggest that repeated exposure to monocrotophos in rats may cause behavioral and neurochemical modifications which may persist even after withdrawal. The findings are of concern in view of the high consumption of monocrotophos in many countries.

### **Profiling of biodegradation and bacterial 16S rRNA genes in diverse contaminated ecosystems using 60-mer oligonucleotide microarray.**

[Pathak A, Shanker R, Garg SK, Manickam N. Appl Microbiol Biotechnol. 2011 Jun;90(5):1739-54.]

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The authors have developed an oligonucleotide microarray for the detection of biodegradative genes and bacterial diversity and tested it in five contaminated ecosystems. The array has 60-mer oligonucleotide probes comprising 14,327 unique probes derived from 1,057 biodegradative genes and 880 probes representing 110 phylogenetic genes from diverse bacterial communities, and we named it as BiodegPhyloChip. The biodegradative genes are involved in the transformation of 133 chemical pollutants. Validation of the microarray for its sensitivity specificity and quantitation were performed using DNA isolated from well-characterized mixed bacterial cultures also having non-target strains, pure degrader strains, and environmental DNA. Application of the developed array using DNA extracted from five different contaminated sites led to the detection of 186 genes, including 26 genes unique to the individual sites. Hybridization of 16S rRNA probes revealed the presence of bacteria similar to well-characterized genera involved in biodegradation of various pollutants. Genes involved in complete degradation pathways for hexachlorocyclohexane (lin), 1,2,4-trichlorobenzene (tcb), naphthalene (nah), phenol (mph), biphenyl (bph), benzene (ben), toluene (tbm), xylene (xyl), phthalate (pht), Salicylate (sal), and resistance to mercury (mer) were detected with highest intensity. The most abundant genes belonged to the enzyme hydroxylases, monooxygenases, and dehydrogenases which were present in all the five samples. Thus, the array developed and validated here shall be useful in assessing not only the biodegradative potential but also the composition of environmentally useful bacteria, simultaneously, from hazardous ecosystems.

### Guidance for safe handling of nanomaterials.

[Dhawan A, Shanker R, Das M, Gupta KC. J Biomed Nanotechnol. 2011 Feb;7(1):218-24.]

The materials at the nanoscale can have different properties compared with same materials at the larger scale. This change in behaviour can be attributed to increased relative surface area and dominance of quantum effects. It has been shown that the nanomaterials can cause adverse effects to human and environmental health. Therefore there is need for developing guidelines for safe use of nanomaterials in the laboratory to minimise exposure to researchers and environment. The purpose of this document is to provide the guidance on proper handling and disposal of nanomaterials (NMs) for personnel involved in activities that entail handling of NMs, in order to minimize risks from exposure to NMs in a laboratory.

### Bacterial decolorization and detoxification of black liquor from rayon grade pulp

### manufacturing paper industry and detection of their metabolic products.

[Chandra R, Abhishek A, Sankhwar M. Bioresour Technol. 2011 Jun;102(11):6429-36.]

This study deals with the decolorization of black liquor (BL) by isolated potential bacterial consortium comprising *Serratia marcescens* (GU193982), *Citrobacter* sp. (HQ873619) and *Klebsiella pneumoniae* (GU193983). The decolorization of BL was studied by using the different nutritional as well as environmental parameters. In this study, result revealed that the ligninolytic activities were found to be growth associated and the developed bacterial consortium was efficient for the reduction of COD, BOD and color up to 83%, 74% and 85%, respectively. The HPLC analysis of degraded samples of BL has shown the reduction in peak area compared to control. Further, the GC-MS analysis showed that, most of the compounds detected in control were diminished after bacterial treatment while, formic acid hydrazide, 4-cyclohexane-1,2-dicarboxylic acid, carbamic acid, 1,2-benzenedicarboxylic acid and erythropentanoic acid were found as new metabolites. Further, the seed germination test using *Phaseolus aureus* has supported the detoxification of bacterial decolorized BL.

### C-Phycocyanin: an effective protective agent against thymic atrophy by tributyltin.

[Gupta M, Dwivedi UN, Khandelwal S. Toxicol Lett. 2011 Jul 4;204(1):2-11.]

*Spirulina platensis*, used worldwide as a food supplement, is a natural source of protein, vitamins, carbohydrates and polyunsaturated fatty acids. C-Phycocyanin (C-Pc), its major biliprotein, is known to possess anti-oxidant, anti-inflammatory and radical scavenging properties. The present study showed that treatment with C-Pc protects the rats from Tributyltin (TBT) induced thymic atrophy. The results reveal TBT-induced oxidative stress mediated apoptosis in rat thymocytes *in vivo* and its attenuation by C-Pc. This ameliorative effect could be attributed to antioxidant activity of the biliprotein. C-Pc also increased TBTC reduced thymic weight and cellularity as well. TBTC-induced ROS generation and lowered GSH levels were restored by C-Pc, suggesting its radical scavenging properties. The various apoptotic determinants such as mitochondrial membrane potential, Bax/Bcl-2 ratio, caspase-3 activity and apoptotic cell population were effectively modulated by C-Pc treatment. This is the first observation to illustrate the effectiveness of C-Pc in reducing TBTC-induced thymic atrophy. The morphology of thymic tissue was restored to near normal by this biliprotein. The present study, therefore, suggests that C-Pc could serve as an effective natural antioxidant for efficient management of TBTC induced oxidative damage.

### Computational analysis and modeling the effectiveness of 'Zanamivir' targeting neuraminidase protein in pandemic H1N1 strains.

[Gupta SK, Gupta SK, Smita S, Srivastava M, Lai X, Schmitz U, Rahman Q, Wolkenhauer O, Vera J. *Infect Genet Evol.* 2011 Jul;11(5):1072-82.]

Antigenic drift causes number of mutations in neuraminidase protein of H1N1 swine influenza virus. The authors analyzed neuraminidase mutations in H1N1 strains distributed over six continents, at both the sequence and structural level. Mutations in the nearby residues of the drug binding site play crucial role in the binding affinity of the drug with the protein. For this purpose, mutant models were generated for the neuraminidase protein from 34 pandemic H1N1 isolates and docking were performed with zanamivir drug. Multiple sequence alignment (MSA) and variations in docking score suggest that there are considerable changes in the binding affinity of neuraminidase with zanamivir, which leads to probable ineffectiveness of zanamivir in the isolated samples of pandemic H1N1 collected from quite a few countries. To further evaluate the effectiveness of the antiviral drugs, The authors derived, calibrated and analyzed an ordinary differential equations based mathematical model for H1N1 infection dynamics and drug mediated virus deactivation.

### Culture-free detection and enumeration of STEC in water.

[Ram S, Vajpayee P, Dwivedi PD, Shanker R. *Ecotoxicol Environ Saf.* 2011 May;74(4):551-7.]

Shiga toxin-producing *Escherichia coli* (STEC) causes worldwide outbreaks of food and waterborne diseases. Rapid identification of causative agents is critical for early intervention in the case of widespread diarrheal epidemics to prevent mortality. In this study, a Molecular-Beacon targeting stx2 gene (highly associated with human illness) was designed to develop a culture-independent real-time PCR assay for detection and quantification of STEC in water samples. The assay could detect lowest 10 genomic equivalent (GE) of the reference strain (*E. coli* I.T.R.C.-18) per PCR or 100 GE/mL. The presence of 10(6)CFU/mL of non-pathogenic *E. coli* DH5 has no impact on sensitivity of the assay. The assay could successfully enumerate STEC in surface water (collected from a sewage impacted river) and potable water samples collected from Lucknow city without prior enrichment. The assay will be useful in pre-emptive monitoring of surface/potable waters to prevent waterborne outbreaks caused by STEC.

### Monocrotophos induced apoptosis in PC12 cells: role of xenobiotic metabolizing cytochrome P450s.

[Kashyap MP, Singh AK, Kumar V, Tripathi VK, Srivastava RK, Agrawal M, Khanna VK, Yadav S, Jain SK, Pant AB. *PLoS One.* 2011 Mar 21;6(3):e17757.]

Monocrotophos (MCP) is a widely used organophosphate (OP) pesticide. The authors studied apoptotic changes and their correlation with expression of selected cytochrome P450s (CYPs) in PC12 cells exposed to MCP. A significant induction in reactive oxygen species (ROS) and decrease in glutathione (GSH) levels were observed in cells exposed to MCP. Following the exposure of PC12 cells to MCP (10(-5) M), the levels of protein and mRNA expressions of caspase-3/9, Bax, Bcl(2), P(53), P(21), GSTP1-1 were significantly upregulated, whereas the levels of Bclw, Mcl1 were downregulated. A significant induction in the expression of CYP1A1/1A2, 2B1/2B2, 2E1 was also observed in PC12 cells exposed to MCP (10(-5) M), whereas induction of CYPs was insignificant in cells exposed to 10(-6) M concentration of MCP. The authors believe that this is the first report showing altered expressions of selected CYPs in MCP-induced apoptosis in PC12 cells. These apoptotic changes were mitochondria mediated and regulated by caspase cascade. Data confirm the involvement of specific CYPs in MCP-induced apoptosis in PC12 cells and also identifies possible cellular and molecular mechanisms of organophosphate pesticide-induced apoptosis in neuronal cells.

### Synergistic growth inhibition of mouse skin tumors by pomegranate fruit extract and diallyl sulfide: evidence for inhibition of activated MAPKs/NF- B and reduced cell proliferation.

[George J, Singh M, Srivastava AK, Bhui K, Shukla Y. *Food Chem Toxicol.* 2011 Jul;49(7):1511-20.]

Limited outcomes from earlier chemopreventive studies have necessitated that some modifications be made to get better efficacy. It is proposed that cancer prevention is more feasible than treatment, and this could be achieved effortlessly with use of multiple agents competent of targeting multiple targets. This study was initiated to examine the chemopreventive efficacy of pomegranate fruit extract (PFE) and diallyl sulfide (DAS), alone and in combination, using 2-stage mouse skin tumorigenesis model. PFE and DAS alone delayed onset and tumor incidence by 55% and 45%, respectively, while their combination at low doses synergistically decreased tumor incidence more potentially (84%, p<0.01). In addition, regression in tumor volume was seen with continuous

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combinatorial treatment ( $p < 0.01$ ). Mechanistic studies revealed that this inhibition was associated with decreased expression of phosphorylated ERK1/2, JNK1 and activated NF- $\kappa$ B/p65, IKK, I $\kappa$ B phosphorylation and degradation in skin tissue/tumor. Histological and cell death analysis also confirmed that combined PFE and DAS inhibit cellular proliferation and markedly induce apoptosis than the single agents. Altogether, results suggest that PFE and DAS in combination impart better suppressive activity than either of these agents alone and provide support that development of novel combination therapies/chemoprevention using dietary agents will be more beneficial against cancer.

### **Bromelain inhibits nuclear factor kappa-B translocation, driving human epidermoid carcinoma A431 and melanoma A375 cells through G(2)/M arrest to apoptosis.**

[Bhui K, Tyagi S, Srivastava AK, Singh M, Roy P, Singh R, Shukla Y. *Mol Carcinog*. 2011 Mar 22. doi: 10.1002/mc.20769. [Epub ahead of print]]

Bromelain, obtained from pineapple, is already in use clinically as adjunct in chemotherapy. The objective was to test its ability to act as a sole anti-cancer agent. Therefore, authors describe its anti-proliferative, anti-inflammatory and subsequent anti-cancer effects *in vitro*, against human epidermoid carcinoma-A431 and melanoma-A375 cells. Bromelain exhibited reduction in proliferation of both these cell-lines and suppressed their potential for anchorage-independent growth. Further, suppression of inflammatory signaling by bromelain was evident by inhibition of Akt regulated-nuclear factor-kappaB activation via suppression of inhibitory-kappaB phosphorylation and concomitant reduction in cyclooxygenase-2. Since, the inflammatory cascade is well-known to be closely allied to cancer; The authors studied the effect of bromelain on events/molecules central to it. Bromelain caused depletion of intracellular glutathione and generation of reactive oxygen-species followed by mitochondrial membrane depolarization. This led to bromelain-induced cell-cycle arrest at G(2)/M phase which was mediated by modulation of cyclin B1, phospho-cdc25C, Plk1, phospho-cdc2, and myt1. This was subsequently followed by induction of apoptosis, indicated by membrane-blebbing, modulation of Bax-Bcl-2 ratio, Apaf-1, caspase-9, and caspase-3; chromatin-condensation, increase in caspase-activity and DNA-fragmentation. Bromelain afforded substantial anti-cancer potential in these settings; hence authors suggest it as a potential prospect for anti-cancer agent besides only an additive in chemotherapy.

### **Environmental lead exposure as a risk for childhood aplastic anemia.**

[Ahamed M, Akhtar MJ, Verma S, Kumar A, Siddiqui MK. *Biosci Trends*. 2011 Feb;5(1):38-43.]

Concern about environmental lead exposure as a significant public health threat has increased as evidence has accumulated regarding adverse health effects at successively lower levels. Aplastic anemia is a hematological disorder of unknown etiology with a high lethality rate. Lead is a known toxicant for the hematopoietic system. Oxidative stress appears to be the possible mode of lead toxicity. Authors evaluated the effects of blood lead level on oxidative stress parameters in children suffering from aplastic anemia disease. Seventeen children with aplastic anemia disease (15 male and 2 female, age 3-12 y) were recruited in the study group. Fifty one healthy children (45 male and 6 female, age 3-12 y) having normal blood profiles and not suffering from any chronic disease(s) were used as controls. Blood lead level and oxidative stress parameters were determined. Mean blood lead level was significantly higher while  $\delta$ -aminolevulinic acid dehydratase ( $\delta$ -ALAD) activity, a biomarker for lead exposure was significantly lower in the study group as compared to the control group ( $p < 0.05$  for each). Thiobarbituric acid reactive species (TBARS), a marker of lipid peroxidation, was significantly higher while the antioxidant glutathione (GSH) level was significantly lower in the study group as compared to the control group ( $p < 0.05$  for each). Activity of the antioxidant enzyme catalase (CAT) was significantly higher in the study group than in the control group ( $p < 0.05$ ). There was a significant negative correlation of blood lead levels with  $\delta$ -ALAD ( $r = -0.45$ ;  $p < 0.05$ ) and GSH ( $r = -0.32$ ;  $p < 0.05$ ), and a positive correlation with TBARS ( $r = 0.41$ ;  $p < 0.05$ ) and CAT ( $r = 0.37$ ;  $p < 0.05$ ). Although a causal pathway cannot be determined from this study, our results indicated that lead induces oxidative stress in children suffering from aplastic anemia. Lead-induced oxidative stress as an underlying mechanism for aplastic anemia warrants further research.

### **Genotoxicity and apoptosis in *Drosophila melanogaster* exposed to benzene, toluene and xylene: attenuation by quercetin and curcumin.**

[Singh MP, Mishra M, Sharma A, Shukla AK, Mudiam MK, Patel DK, Ram KR, Chowdhuri DK *Toxicol Appl Pharmacol*. 2011 May 15;253(1):14-30.]

Monocyclic aromatic hydrocarbons (MAHs) such as benzene, toluene and xylene are being extensively used for various industrial and household purposes. Exposure to these hydrocarbons, occupationally or non-occupationally, is harmful to organisms including human. Several studies tested for toxicity of benzene, toluene and xylene, and interestingly, only a few studies looked into the attenuation. The authors used *Drosophila* model to

test the genotoxic and apoptotic potential of these compounds and subsequently evaluated the efficiency of two phytochemicals, namely, quercetin and curcumin in attenuating test chemical induced toxicity. The authors exposed third instar larvae of wild type *Drosophila melanogaster* (Oregon R+) to 1.0-100.0 mM benzene, toluene or xylene, individually, for 12, 24 and 48 h and examined their apoptotic and genotoxic potential. The authors observed significantly ( $P < 0.001$ ) increased apoptotic markers and genotoxicity in a concentration- and time-dependent manner in organisms exposed to benzene, toluene or xylene. The authors also observed significantly ( $P < 0.001$ ) increased cytochrome P450 activity in larvae exposed to test chemicals and this was significantly reduced in the presence of 3',4'-dimethoxyflavone, a known Aryl hydrocarbon receptor (AhR) blocker. Interestingly, they observed a significant reduction in cytochrome P450 activity, GST levels, oxidative stress parameters, genotoxic and apoptotic endpoints when organisms were exposed simultaneously to test chemical along with quercetin or curcumin. The study further suggests the suitability of *D. melanogaster* as an alternate animal model for toxicological studies involving benzene, toluene and xylene and its potential in studying the protective role(s) of phytochemicals.

### Studies on urban drinking water quality in a tropical zone.

[Mudiam MK, Pathak SP, Gopal K, Murthy RC. Environ Monit Assess. 2011 Mar 17 DOI 10.1007/s10661-011-1980-3.. [Epub ahead of print]]

Anthropogenic activities associated with industrialization, agriculture and urbanization have led to the deterioration in water quality due to various contaminants. To assess the status of urban drinking water quality, samples were collected from the piped supplies as well as groundwater sources from different localities of residential, commercial and industrial areas of Lucknow City in a tropical zone of India during pre-monsoon for estimation of coliform and faecal coliform bacteria, organochlorine pesticides (OCPs) and heavy metals. Bacterial contamination was found to be more in the samples from commercial areas than residential and industrial areas. OCPs like  $\alpha$ -hexachlorocyclohexane and 1,1 p,p-DDE {dichloro-2, 2-bis(p-chlorophenyl) ethene} were found to be present in most of the samples from study area. The total organochlorine pesticide levels were found to be within the European Union limit (0.5  $\mu\text{g/L}$ ) in most of the samples. Most of the heavy metals estimated in the samples were also found to be within the permissible limits as prescribed by World Health Organization for drinking water. Thus, these observations show that contamination of drinking water in urban areas may be mainly due to municipal, industrial and agricultural activities along with improper disposal of solid waste. This

is an alarm to safety of public health and aquatic environment in tropics.

### Tracing the tracks of genotoxicity by trivalent and hexavalent chromium in *Drosophila melanogaster*.

[Mishra M, Sharma A, Negi MP, Dwivedi UN, Chowdhuri DK. Mutat Res. 2011 May 18;722(1):44-51.]

Mutagen sensitive strains (mus) in *Drosophila* are known for their hypersensitivity to mutagens and environmental carcinogens. Accordingly, these mutants were grouped in pre- and post-replication repair pathways. However, studying mutants belonging to one particular repair pathway may not be adequate for examining chemical-induced genotoxicity when other repair pathways may neutralize its effect. To test whether both pre- and post-replication pathways are involved and effect of Cr(III)- and Cr(VI)-induced genotoxicity in absence or presence of others, authors used double mutant approach in *D. melanogaster*. They observed DNA damage as evident by changes in Comet assay DNA migration in cells of larvae of Oregon R(+) and single mutants of pre- (mei-9, mus201 and mus210) and post- (mei-41, mus209 and mus309) replication repair pathways and also in double mutants of different combinations (pre-pre, pre-post and post-post replication repair) exposed to increasing concentrations of Cr(VI) (0.0, 5.0, 10.0 and 20.0  $\mu\text{g/ml}$ ) for 48 h. The damage was greater in pre-replication repair mutants after exposure to 5.0  $\mu\text{g/ml}$  Cr(VI), while effects on Oregon R(+) and post replication repair mutants were insignificant. Post-replication repair mutants revealed significant DNA damage after exposure to 20.0  $\mu\text{g/ml}$  Cr(VI). Further, double mutants generated in the above repair categories were examined for DNA damage following Cr(VI) exposure and a comparison of damage was studied between single and double mutants. Combinations of double mutants generated in the pre-pre replication repair pathways showed an indifferent interaction between the two mutants after Cr(VI) exposure while a synergistic interaction was evident in exposed post-post replication repair double mutants. Cr(III) (20.0  $\mu\text{g/ml}$ ) exposure to these strains did not induce any significant DNA damage in their cells. The study suggests that both pre- and post-replication pathways are affected in *Drosophila* by Cr(VI) leading to genotoxicity, which may have consequences for metal-induced carcinogenesis.

### Ubiquitous hazardous metal lead induces TNF- $\alpha$ in human phagocytic THP-1 cells: primary role of ERK 1/2.

[Khan MI, Islam N, Sahasrabudde AA, Mahdi AA, Siddiqui H, Ashquin M, Ahmad I. J Hazard Mater. 2011 May 15;189(1-2):255-64.]

Induction of tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) in response

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to lead (Pb) exposure has been implicated in its immunotoxicity. However, the molecular mechanism by which Pb upregulates the level of TNF- $\alpha$  is vaguely known. An attempt was therefore made to elucidate the mechanistic aspect of TNF- $\alpha$  induction, mainly focusing transcriptional and post transcriptional regulation via mitogen activated protein kinases (MAPKs) activation. Authors observed that exposure of Pb to human monocytic THP-1 cells resulted in significant enhanced production of TNF- $\alpha$  mRNA and protein secretion. Moreover, the stability of TNF- $\alpha$  mRNA was also increased as indicated by its half life. Notably, activation of ERK 1/2, p38 and JNK in Pb exposed THP-1 was also evident. Specific inhibitor of ERK1/2, PD 98059 caused significant inhibition in production and stability of TNF- $\alpha$  mRNA. However, SB 203580 partially inhibited production and stability of TNF- $\alpha$  mRNA. Interestingly, a combined exposure of these two inhibitors completely blocked modulation of TNF- $\alpha$  mRNA. Data tends to suggest that expression and stability of TNF- $\alpha$  induction due to Pb exposure is mainly regulated through ERK. Briefly, these observations are useful in understanding some mechanistic aspects of proinflammatory and immunotoxicity of Pb, a globally acknowledged key environmental contaminant.

### Neoplastic alterations induced in mammalian skin following mancozeb exposure using *in vivo* and *in vitro* models.

[Tyagi S, George J, Singh R, Bhui K, Shukla Y. OMICS. 2011 Mar;15(3):155-67.]

Mancozeb, ethylene(bis)dithiocarbamate fungicides, has been well documented in the literature as a multipotent carcinogen, but the underlying mechanism remains unrevealed. Thus, mancozeb has been selected in this study with the objective to decipher the molecular mechanism that culminates in carcinogenesis. The authors employed two-dimensional gel electrophoresis and mass spectrometry to generate a comparative proteome profile of control and mancozeb (200 mg/kg body weight) exposed mouse skin. Although many differentially expressed proteins were found, among them, two significantly upregulated proteins, namely, S100A6 (Calcyclin) and S100A9 (Calgranulin-B), are known markers of keratinocyte differentiation and proliferation, which suggested their role in mancozeb-induced neoplastic alterations. Therefore, they verified these alterations in the human system by using HaCaT cells as an *in vitro* model for human skin keratinocyte carcinogenesis. Upregulation of these two proteins upon mancozeb (0.5  $\mu$ g/mL) exposure in HaCaT cells indicated its neoplastic potential in human skin also. This potential was confirmed by increase in number of colonies in colony formation and anchorage-independent growth assays. Modulation of S100A6/S100A9 targets, elevated

phosphorylation of extracellular signal regulated kinase (ERK1/2), Elk1, nuclear factor- $\kappa$ B and cell division cycle 25 C phosphatase, and cyclin D1 and cyclooxygenase-2 upregulation was seen. In addition, PD98059 (ERK1/2 inhibitor) reduced cell proliferation induced by mancozeb, confirming the involvement of ERK1/2 signaling. Conclusively, authors herein present the first report asserting that the mechanism involving S100A6 and S100A9 regulated ERK1/2 signaling underlies the mancozeb-induced neoplastic potential in human skin.

### Polymorphism of xenobiotic-metabolizing genes and breast cancer susceptibility in North Indian women.

[Singh V, Upadhyay G, Rastogi N, Singh K, Singh MP. Genet Test Mol Biomarkers. 2011 May;15(5):343-9.]

NAD(P)H:quinone oxidoreductase 1 (NQO1) and cytochrome P450 1A2 (CYP1A2) are involved in the metabolism of estrogens. Genetic polymorphisms in these genes may lead to interindividual variation in breast cancer susceptibility. This study was undertaken to investigate the association of NQO1 exon 6 proline187serine (C609T) and CYP1A2 exon 2 phenylalanine21leucine (C63G) polymorphisms with breast cancer susceptibility in North Indian women. Polymorphisms were analyzed by polymerase chain reaction amplification of the desired segment of NQO1 and CYP1A2 genes followed by restriction fragment length polymorphism. NQO1 mRNA expression was analyzed by semiquantitative reverse transcription-polymerase chain reaction and its enzyme activity was estimated spectrofluorometrically. Odds ratios for NQO1 C609T heterozygous and homozygous variants were 0.66 (95% confidence interval: 0.39-1.13; p-value: 0.141) and 1.07 (95% confidence interval: 0.46-2.46; p-value: 0.976). All cases and controls were monomorphic for the CYP1A2 exon 2 phenylalanine21leucine (C63G) genotype. NQO1 mRNA expression and its catalytic activity among wild-type genotype, homozygous variant, and heterozygous variant were not significantly altered, except for catalytic activity of the NQO1 homozygous variant, which was observed extremely low. The results of the study suggest that NQO1 exon 6 proline187serine (C609T) and CYP1A2 exon 2 phenylalanine21leucine (C63G) polymorphisms do not play a significant role in breast cancer susceptibility in North Indian women.

### Cellular uptake and mutagenic potential of metal oxide nanoparticles in bacterial cells.

[Kumar A, Pandey AK, Singh SS, Shanker R, Dhawan A. Chemosphere. 2011 May;83(8):1124-32.]

Extensive production and consumption of nanomaterials such as ZnO and TiO<sub>2</sub> has increased their release and

disposal into the environment. The accumulation of nanoparticles (NPs) in ecosystem is likely to pose threat to non-specific targets such as bacteria. The present study explored the effect of ZnO and TiO<sub>2</sub> NPs in a model bacterium, *Salmonella typhimurium*. The uptake of ZnO and TiO<sub>2</sub> bare NPs in nano range without agglomeration was observed in *S. typhimurium*. TEM analysis demonstrated the internalization and uniform distribution of NPs inside the cells. Flow cytometry data also demonstrates that both ZnO and TiO<sub>2</sub> NPs were significantly internalized in the *S. typhimurium* cells in a concentration dependent manner. A significant increase in uptake was observed in the *S. typhimurium* treated even with 8 and 80 ng mL<sup>-1</sup> of ZnO and TiO<sub>2</sub> NPs with S9 after 60 min, possibly the formation of micelles or protein coat facilitated entry of NPs. These NPs exhibited weak mutagenic potential in *S. typhimurium* strains TA98, TA1537 and *Escherichia coli* (WP2uvrA) of Ames test underscoring the possible carcinogenic potential similar to certain mutagenic chemicals. Present study reiterates the need for re-evaluating environmental toxicity of ZnO and TiO<sub>2</sub> NPs presumably considered safe in environment.

### Toxic responses in primary rat hepatocytes exposed with occupational dust collected from work environment of bone-based industrial unit.

[Ahmad I, Siddiqui H, Akhtar MJ, Khan MI, Patil G, Ashquin M, Patel DK, Arif JM. *Chemosphere*. 2011 Apr;83(4):455-60.]

In this *in vitro* study authors investigated the toxic responses in hepatocytes treated with occupational dust to which workers are exposed in bone-based industrial units. The present study investigated the toxicity mechanism of bone-based occupational dust, from a particular industrial unit, on isolated rat hepatocytes. The hepatocytes were isolated by collagenase perfusion method and cell viability was determined by trypan blue exclusion and MTT [3-(4,5-dimethyl thiazol-2-yl)-2,5-diphenyl tetrazolium bromide] assay treated with occupational dust at 0.1-1.0 mgmL<sup>-1</sup>, for 120 min. The cell viability decreased significantly in a concentration-dependent manner. Dust induced significant membrane damage measured by lactate dehydrogenase (LDH) and glutathione (GSH) release in culture media for 30-, 60- and 120 min treatment duration. The toxicity was found to be correlated with the induction of lipid peroxidation (LPO). In addition, nitric oxide (NO), and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) generation by occupational dusts were also found to be time- and concentration-dependent. Over all the present study provides initial evidences for the toxic potential of occupational dust generated in bone-based industries and, therefore, the dust exposure to workers in

unorganized industrial units should be controlled.

### Optimizing adsorption of crystal violet dye from water by magnetic nanocomposite using response surface modeling approach.

[Singh KP, Gupta S, Singh AK, Sinha S. *J Hazard Mater*. 2011 Feb 28;186(2-3):1462-73.]

A magnetic nanocomposite was developed and characterized. Adsorption of crystal violet (CV) dye from water was studied using the nanocomposite. A four-factor central composite design (CCD) combined with response surface modeling (RSM) was employed for maximizing CV removal from aqueous solution by the nanocomposite based on 30 different experimental data obtained in a batch study. Four independent variables, viz. temperature (10-50°C), pH of solution (2-10), dye concentration (240-400 mg/l), and adsorbent dose (1-5 g/l) were transformed to coded values and a second-order quadratic model was built to predict the responses. The significance of independent variables and their interactions were tested by the analysis of variance (ANOVA) and t-test statistics. Adequacy of the model was tested by the correlation between experimental and predicted values of the response and enumeration of prediction errors. Optimization of the process variables for maximum adsorption of CV by nanocomposite was performed using the quadratic model. The Langmuir adsorption capacity of the adsorbent was determined as 81.70 mg/g. The model predicted maximum adsorption of 113.31 mg/g under the optimum conditions of variables (concentration 240 mg/l; temperature 50°C; pH 8.50; dose 1g/l), which was very close to the experimental value (111.80 mg/g) determined in batch experiment.

### Modulation of Bax/Bcl-2 and caspases by probiotics during acetaminophen induced apoptosis in primary hepatocytes.

[Sharma S, Singh RL, Kakkar P. *Food Chem Toxicol*. 2011 Apr;49(4):770-9.]

Oxidative stress is an important factor in drug induced hepatotoxicity and antioxidants from natural sources have potential to ameliorate it. The present study was aimed to investigate cyto-protective potential of probiotic *Enterococcus lactis* IITRHR1 (EI(SN)) and *Lactobacillus acidophilus* MTCC447 (La(SN)) lysate against acetaminophen (APAP) induced hepatotoxicity. Cultured rat hepatocytes pretreated with EI(SN)/La(SN) showed higher cell viability under APAP stress. Pre-treatment with EI(SN) restored glutathione level and reduced ROS generation significantly which are major biomarkers of oxidative stress. It also reduced NO level, MDA formation and enhanced SOD activity. Pre-treatment with probiotic lysates significantly inhibited the translocation of pro-apoptotic protein (Bax), enhanced anti-apoptotic (Bcl-2)

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protein levels and prevented release of cyt c to cytosol; suggesting involvement of mitochondrial proteins in protection against APAP induced oxidative cellular damage. Loss in mitochondrial membrane potential due to APAP treatment was prevented in the presence of probiotic lysates. Protective action of EI(SN)/La(SN) pretreatment was further supported by prevention of procaspase-3 activation, DNA fragmentation and chromatin condensation, in turn inhibiting APAP induced apoptotic cell death. The results indicate that probiotic preparations modulate crucial end points of oxidative stress induced apoptosis and may be used for management of drug induced liver injury.

### Bacterial decolorization of black liquor in axenic and mixed condition and characterization of metabolites.

[Chandra R, Abhishek A. Biodegradation. 2011 Jun;22(3):603-11.]

The pulping byproducts (black liquor) cause serious environmental problem due to its high pollution load. In order to search the degradability of black liquor, the potential bacterial strains *Citrobacter freundii* (FJ581026) and *Citrobacter* sp. (FJ581023) were applied in axenic and mixed condition. Results revealed that the mixed bacterial culture are more effective than axenic condition and can reduce 82% COD, 79% AOX, 79% color and 60% lignin after 144 h of incubation period. Additionally, the optimum activity of lignin degrading enzyme was noted at 96 h and characterized as manganese peroxidase (MnP) by SDS-PAGE analysis. Further, the HPLC analysis of control and bacterial degraded sample has shown the reduction as well as shifting of peaks compared to control indicating the degradation as well as transformation of compounds of black liquor. The comparative GC-MS analysis of control and degraded black liquor revealed that along with lignin fragment some chlorophenolic compounds 2,4,6-trichlorophenol, 2,3,4,5-tetrachlorophenol and pentachlorophenol were detected in black liquor degraded by axenic culture whereas these

chlorophenolic compounds were completely absent in black liquor degraded by mixed bacterial culture. These chlorophenol inhibit the oxidative degradation which seems a major reason behind the low degradability of axenic degradation compared to mixed culture. The innovation of this aerobic treatment of alkaline black liquor opens additional possibilities for the better treatment of black liquor along with its metabolic product.

### Environmental chemical mediated male reproductive toxicity: *Drosophila melanogaster* as an alternate animal model.

[Tiwari AK, Pragma P, Ravi Ram K, Chowdhuri DK. Theriogenology. 2011 Jul 15;76(2):197-216.]

Industrialization and indiscriminate use of agrochemicals have increased the human health risk. Recent epidemiological studies raised a concern for male reproduction given their observations of reduced sperm counts and altered semen quality. Interestingly, environmental factors that include various metals, pesticides and their metabolites have been causally linked to such adversities by their presence in the semen at levels that correlate to infertility. The epidemiological observations were further supported by studies in animal models involving various chemicals. Therefore, in this review, the authors focused on male reproductive toxicity and the adverse effects of different environmental chemicals on male reproduction. However, it is beyond the scope of this review to provide a detailed appraisal of all of the environmental chemicals that have been associated with reproductive toxicity in animals. Here, they provided the evidence for reproductive adversities of some commonly encountered chemicals (pesticides/metals) in the environment. In view of the recent thrust for an alternate to animal models in research, they subsequently discussed the contributions of *Drosophila melanogaster* as an alternate animal model for quick screening of toxicants for their reproductive toxicity potential. Finally, authors emphasized the genetic and molecular tools offered by *Drosophila* for understanding the mechanisms underlying the male reproductive toxicity.

## TOPIC OF INTEREST

### Environmental Impact Assessment : Indian status

#### Effect of sulphur and phosphorus on yield, quality and nutrient status of pigeonpea (*Cajanus cajan*).

[Deshbhratar PB, Singh PK, Jambhulkar AP, Ramteke DS. J Environ Biol. 2010 Nov;31(6):933-7.]

A field experiment was conducted to study the impact of Sulphur(S) and Phosphorus (P) on yield, nutrient status of soil and their contents in pigeonpea (*Cajanus cajan*) during the year 2008-2009. Seven treatments were

studied in Factorial Randomized Block Design with three replications. The treatment combinations were derived from three levels of sulphur (0, 20 and 40 kg S ha<sup>-1</sup>) and four levels of phosphorus (0, 25, 50 and 75 kg ha<sup>-1</sup>). The experimental soil was medium black, slightly calcareous, clay in texture and slightly alkaline in reaction. The results indicated a significant increase in grain yield (14.81 q ha<sup>-1</sup>) and straw yield (41.26 q ha<sup>-1</sup>) of pigeonpea after 20



kg S ha<sup>-1</sup>) and 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) treatment with common dose of nitrogen @ 30 kg ha<sup>-1</sup>). The increase in grain and straw yield was 102.77 and 52.87% as compare to higher over control. Maximum number of pods plant<sup>-1</sup>), maximum number of grains pod and test weight by this treatment was also observed as compared to control. Application of S and P improved soil fertility status and S alone did not influence P availability. Hence, in order to maintain the fertility status of the soil at high level, combine application of 20 kg S ha<sup>-1</sup>) with 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) is essential. The residual fertility status of soil is advocated for rainfed pigeonpea crop grown on vertisol in Vidarbha region.

#### **Groundwater quality and water quality index at Bhandara District.**

[Rajankar PN, Tambekar DH, Wate SR. Environ Monit Assess. 2011 Aug;179(1-4):619-25. Epub 2010 Nov 10.]

The present investigation reports the results of a monitoring study focusing on groundwater quality of Bhandara District of central India. Since, remediation of groundwater is very difficult, knowledge of the existing nature, magnitude, and sources of the various pollution loads is a prerequisite to assessing groundwater quality. The water quality index (WQI) value as a function of various physicochemical and bacteriological parameters was determined for groundwater obtained from a total of 21 locations. The WQI during pre-monsoon season varied from 68 to 83, while for post-monsoon, it was between 56 and 76. Significantly ( $P < 0.01$ ) lower WQI for the post-monsoon season was observed, indicating deterioration of the groundwater overall in corresponding season. The study revealed that groundwater from only 19% locations was fit for domestic use, thus indicating the need of proper treatment before use.

#### **Environmental impact assessment of sand mining from the small catchment rivers in the southwestern coast of India: a case study.**

[Sreebha S, Padmalal D. Environ Manage. 2011 Jan;47(1):130-40. Epub 2010 Oct 7.]

In the past few decades, the demand for construction grade sand is increasing in many parts of the world due to rapid economic development and subsequent growth of building activities. This, in many of the occasions, has resulted in indiscriminate mining of sand from in-stream and floodplain areas leading to severe damages to the river basin environment. The case is rather alarming in the small catchment rivers like those draining the southwestern coast of India due to limited sand resources in their alluvial reaches. Moreover, lack of adequate information on the environmental impact of river sand mining is a major lacuna challenging regulatory efforts in

many developing countries. Therefore, a scientific assessment is a pre-requisite in formulating management strategies in the sand mining-hit areas. In this context, a study has been made as a case to address the environmental impact of sand mining from the in-stream and floodplain areas of three important rivers in the southwestern coast of India namely the Chalakudy, Periyar and Muvattupuzha rivers, whose lowlands host one of the fast developing urban-cum-industrial centre, the Kochi city. The study reveals that an amount of 11.527 million ty<sup>-1</sup>) of sand (8.764 million ty<sup>-1</sup>) of in-stream sand and 2.763 million ty<sup>-1</sup>) of floodplain sand) is being mined from the midland and lowland reaches of these rivers for construction of buildings and other infrastructural facilities in Kochi city and its satellite townships. Environmental Impact Assessment (EIA) carried out as a part of this investigation shows that the activities associated with mining and processing of sands have not only affected the health of the river ecosystems but also degraded its overbank areas to a large extent. Considering the degree of degradation caused by sand mining from these rivers, no mining scenario may be opted in the deeper zones of the river channels. Also, a set of suggestions are made for the overall improvement of the rivers and its biophysical environment.

#### **Screening for EIA in India: enhancing effectiveness through ecological carrying capacity approach.**

[Rajaram T, Das A. J Environ Manage. 2011 Jan;92(1):140-8.]

Developing countries across the world have embraced the policy of high economic growth as a means to reduce poverty. This economic growth largely based on industrial output is fast degrading the ecosystems, jeopardizing their long term sustainability. Environmental Impact Assessment (EIA) has long been recognized as a tool which can help in protecting the ecosystems and aid sustainable development. The Screening guidelines for EIA reflect the level of commitment the nation displays towards tightening its environmental protection system. The paper analyses the screening process for EIA in India and dissects the rationale behind the exclusions and thresholds set in the screening process. The screening process in India is compared with that of the European Union with the aim of understanding the extent of deviations from a screening approach in the context of better economic development. It is found that the Indian system excludes many activities from the purview of screening itself when compared to the EU. The constraints responsible for these exclusions are discussed and the shortcomings of the current command and control system of environmental management in India

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are also explained. It is suggested that an ecosystem carrying capacity based management system can provide significant inputs to enhance the effectiveness of EIA process from screening to monitoring.

#### **Adsorption of fluoride from water by surface-functionalized polyurethane foam.**

[Krupadam RJ, Khan MS, Das S. *Water Sci Technol.* 2010;62(4):759-65.]

Surface-functionalized polyurethane foam (SPUF) showed an exceptionally high adsorption potential for defluoridation of drinking water. Kinetic experiments of fluoride adsorption on SPUF demonstrated quick adsorption in first 60 min and then achieved maximum adsorption (7.8 mg g<sup>-1</sup>). The adsorption isotherm was described using Bradley equation. The adsorption capacity of SPUF was significantly influenced by the pH of the solution. The highest adsorption capacity was attained at pH 6.7 and no drastic reduction noticed in the adsorption capacity of SPUF at normal pH range (5.8-8.2). The fluoride adsorption capacity of SPUF was compared with other adsorbents like activated carbon, soil, alumina and carbon nanotubes. The added advantage of SPUF adsorbent is, it can be easily recharged by altering the pH of the solution using NaOH or Ca(OH)<sub>2</sub>. The high adsorption capacity and easy-to-use nature of SPUF in batch mode and continuous system makes the new adsorbent a promising material for defluoridation of drinking water.

#### **Vermifilters: a tool for aerobic biological treatment of herbal pharmaceutical wastewater.**

[Dhadse S, Satyanarayan S, Chaudhari PR, Wate SR. *Water Sci Technol.* 2010;61(9):2375-80.]

Herbal pharmaceutical wastewater possesses high chemical oxygen demand (COD) (21,960-26,000 mg/l) and biochemical oxygen demand (BOD) (11,200-15,660 mg/l) and suspended solids (SS) (5,460-7,370 mg/l). It cannot be directly discharged into surface water bodies, due to its highly biodegradable nature. Herbal pharmaceutical wastewater has been treated by using vermifilter, which is an ecosystem consisting of bio soil with bacteria and earthworms producing vermicastings. In the present studies a cost-effective, eco-friendly and sustainable method has been applied for the treatment of herbal pharmaceutical wastewater using earthworms. Studies were carried out at different organic loadings, ranging between 0.8 and 3.2 kg COD/m<sup>3</sup>/day at three different hydraulic loadings of 1, 2 and 4 days. Vermifilters packed with 1:1:1 ratio of soil, sand and vermicast as media matrix along with the twenty adult earthworms in each reactor was used for the experiments. Treated

effluent was colour and odour free. Efficient COD/BOD removals in the range of 85.44%-94.48% and 89.77%-96.26% were obtained respectively at 2 days hydraulic retention time (HRT). Heavy metal removals were also observed and no sludge production problem was encountered, only nutrient rich vermicast from the filters were removed and analysed after the experiments. It showed higher manurial value than control in terms of available nitrogen, phosphorus and potassium (NPK) and were in the range of 178.75-278.75 Kg/hectare available nitrogen, 16.128-50.4 kg/hectare of available phosphorus and 19.3-28.6 kg/hectare of available potassium at maximum HRT and at different organic loadings. This paper discusses in detail the feasibility of vermifilters in herbal pharmaceutical wastewater treatment at different organic and hydraulic loadings.

#### **Monitoring water quality of Coimbatore wetlands, Tamil Nadu, India.**

[Chandra R, Nishadh KA, Azeed PA. *Environ Monit Assess.* 2010 Oct;169(1-4):671-6. Epub 2009 Nov 10.]

Signs of wetland-water quality degradation have been apparent for decades, especially in those wetlands situated in the vicinity of cities and human habitations. Investigation on four urban wetlands of Coimbatore have been undertaken to assess the water quality with reference to pollution from various sources. The pH and total dissolved solids (TDS) values of the lakes were found to be different from those reported almost a decade back. The concentrations of phosphate and sulphate were much lower than the earlier reported values. The present scenario states that though the biochemical oxygen demand and chemical oxygen demand values were lower for the Ukkadam wetland, the values for Perur wetland have shown a gradual increase. Alkalinity and chloride concentrations were thrice higher than the previous findings. Electrical conductivity and TDS ranged from 303.67 to 4,456.7  $\mu$ S/cm and from 169 to 2,079.3 mg/l, respectively, and were positively correlated with chloride and sulphate ( $P < 0.05$ ). These changes are a reflection of the environmental changes happening in the cityscape of the Coimbatore, a fast-growing city in south India.

#### **Application of water quality index for assessment of surface water quality surrounding integrated industrial estate-Pantnagar.**

[Banerjee T, Srivastava RK. *Water Sci Technol.* 2009;60(8):2041-53.]

Water pollution as a consequence of accelerated industrial growth has drawn concerns over public health and environment. In order to assess the extent of environmental impact due to integrated industrial estate-Pantnagar (IIE-Pantnagar), surface water was monitored

for duration of one year. Grab surface water samples from 12 locations were collected, processed and analyzed for 11 pre-identified variables. Besides providing the raw baseline data, the information was normalized and integrated by applying Water Quality Index (WQI). The average surface water quality surrounding IIE-Pantnagar was found to be satisfactory in terms of its potability after conventional treatment and disinfection. During summer season, the WQI of Baigul River at Haldi Road illustrated good water quality (83.3), which however, deteriorates in its downstream at Rudrapur (55.5), signifying moderate quality. The WQI inside IIE-Pantnagar varied from 47.4 to 66.6, revealing moderate to good surface water quality. However, in monsoon and post-monsoon seasons, WQI demonstrated a modest increase in quality for all sampling points, with a few exceptions due to dilution caused by monsoonal rainfall. In this period, average WQI varied from 49.6 to 81.7. During winter season, WQI further declined due to cumulative effects of industrial discharge from IIE-Pantnagar and other adjacent industrial set-ups coupled with municipal waste water from Rudrapur city. The lowest WQI for entire sampling network was found within IIE-Pantnagar as 37.1, revealing poor water quality. The application of WQI to assess temporal variations in surface water quality was therefore found satisfactory.

#### **Selection of indicator bacteria based on screening of 16S rDNA metagenomic library from a two-stage anoxic-oxic bioreactor system degrading azo dyes.**

[Dafale N, Agrawal L, Kapley A, Meshram S, Purohit H, Wate S. *Bioresour Technol.* 2010 Jan;101(2):476-84. Epub 2009 Sep 11.]

Dye degradation has gained attention of late due to indiscriminate disposal from user industries. Enhancing efficiency of biological treatment provides a cheaper alternative vis-à-vis other advanced technologies. Dye molecules are metabolized biologically via anoxic and oxic treatments. In this study, bacterial community surviving on dye effluent working in anoxic-oxic bioreactor was analyzed using 16S rDNA approach. Azo-dye decolorizing and degrading bacterial community was enriched in lab-scale two-stage anoxic-oxic bioreactor. 16S rDNA metagenomic libraries of enriched population were constructed, screened and phylogenetically analyzed separately. Removal of approximately 35% COD with complete decolorization was observed in anoxic bioreactor. Process was carried out by uncultured gamma proteobacterium constituting 48% of the total population and 12% clones having homology to *Klebsiella*. Aromatic amines generated during partial treatment under anoxic bioreactor were treated by aerobic population having 72% unculturable unidentified bacterium and rest of the population consisting of *Thaueria*

sp., *Pseudoxanthomonas* sp., *Desulfomicrobium* sp., *Ottowia* sp., *Acidovorax* sp., and *Bacterioidetes bacterium* sp.

#### **Impact assessment of coal mines in Erai watershed of Chandrapur district using geoinformatics.**

[Patil SA, Katpatal YB. *J Environ Sci Eng.* 2008 Oct;50(4):271-6.]

The industrial development and growing population in India is in demand of more energy. Coal based thermal power generation is a major source of energy and is expanding at a very high rate leading to over exploitation of coal reserves, which is causing adverse impacts on the environment. Remote sensing and GIS techniques have been found to be useful in mapping and monitoring of dynamic changes taking place due to mining activity. Satellite based environmental impact assessment involves various aspects, such as land use, water resources, land degradation, etc. These studies help in formulating environmental management plan for the mining sector. Coal mines in Erai watershed of Chandrapur district so far have lost 2139.68 hectares of land constituting a fertile agriculture land, reserve forest, protected forest and natural river course of Erai river, Ursa nala and Motaghat nala severely affecting the watershed eco-system. Therefore, an in-depth impact assessment study of coal mines in Erai watershed of Chandrapur district was carried out using geoinformatics and the results are presented in this paper.

#### **Environmental impact of plantations in and around the petroleum refinery: a case study.**

[Rao PS, Mhaisalkar VA, Shrivastava A, Kumar A, Chakrabarti T, Devotta S. *Environ Monit Assess.* 2010 Sep;168(1-4):55-61.]

Plantation or green belt (GB) grown around the factories and industrial premises improves the condition of land, mitigates air pollution (as the plants serve as a sink for pollutants and check the flow of dust, etc.), and reduces the level of noise pollution. The software developed by NEERI for the determination of the optimal width of GB in and around an industry is based on the pollution attenuation coefficient of selected plant species of deciduous trees existing in the region. The assessment of the impact of these plantations/green belts of 500-m width in and around a petroleum refinery in the west coast of India is evaluated for reducing/managing various waste generated, and it is observed that the overall efficiency is more than 60%.

#### **GIS based procedure of cumulative environmental impact assessment.**

[Balakrishna Reddy M, Blah B. *J Environ Sci Eng.* 2009 Jul;51(3):191-8.]

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Scale and spatial limits of impact assessment study in a GIS platform are two very important factors that could have a bearing on the genuineness and quality of impact assessment. While effect of scale has been documented and well understood, no significant study has been carried out on spatial considerations in an impact assessment study employing GIS technique. A novel technique of impact assessment demonstrable through GIS approach termed hereby as 'spatial data integrated GIS impact assessment method (SGIAM)' is narrated in this paper. The technique makes a fundamental presumption that the importance of environmental impacts is dependent, among other things, on spatial distribution of the effects of the proposed action and of the affected receptors in a study area. For each environmental component considered (e.g., air quality), impact indices are calculated through aggregation of impact indicators which are measures of the severity of the impact. The presence and spread of environmental descriptors are suitably quantified through modeling techniques and depicted. The environmental impact index is calculated from data exported from ArcINFO, thus giving significant importance to spatial data in the impact assessment exercise.

**Environmental quality assessment studies of coal handling on peripheral land near Kanika siding, Basundhra-Garjanbahal area of MCL, Sundergarh, Orissa, India.**

[Pradhan K, Mishra PC, Avishek K. Environ Monit Assess. 2010 Apr;163(1-4):115-23]

Coal has been recognized as the most important source of energy generation in India. The present work was undertaken in order to assess the environmental impact of coal handling on peripheral land under near Kanika siding, Orissa, India. The data on suspended particulates in ambient air indicates an additional load of 50.5-108.7 microg/m(3) to the ambient air due to coal loading which is equivalent to 50 x 365 to 108 x 365 kg/year. However, in the southern side (opposite to siding) covering the crop fields, the dust accumulation was maximum, i.e., 0.021 to 0.035 mg/cm(2) area in comparison to 0.001 to 0.021 in the eastern side and 0.001 to 0.029 in western side of the crop fields. The physical and chemical properties of soil was also assessed. The results reveal that the coal loading has definite negative impact on the peripheral land near the site.

**Indifference curves as a tool for environment impact assessment.**

[Srivastava A, Ganguly A. Environ Monit Assess. 2010 Jan;160(1-4):513-9.]

Use of indifference curves, defined as functionality between development index and pollution load to

evaluate environmental impact, is proposed. Existing Battelle environmental evaluation methodology is subjective in its approach. The use of indifference curves lends a more objective approach to environment assessment methodology. The extent of environmental damage we are prepared to accept, for a development, can be explained by Willingness to Pay and Willingness to Accept approach. The application of proposed approach has been demonstrated taking an example of Power plant set up in forest area. The curves clearly show that cost of EMP considering mitigation of ecological damage is higher than the EMP mitigating impacts of air and water pollution only. The example stresses the need for willingness to accept along with willingness to pay.

**Energy efficient--advanced oxidation process for treatment of cyanide containing automobile industry wastewater.**

[Mudliar R, Umare SS, Ramteke DS, Wate SR. J Hazard Mater. 2009 May 30;164(2-3):1474-9.]

Destruction of cyanide (CN) from an automobile industry wastewater by advance oxidation process (AOP) has been evaluated. The operating conditions (in an indigenously designed photoreactor) for three different treatment strategies have been optimized. The treatment strategies involved use of, ultra violet light (UV), hydrogen peroxide (H(2)O(2)) and ozone (O(3)) in various combinations. Treatment of automobile industry wastewater (250 mg/L CN) showed fastest CN destruction, which was significantly (P<0.05) faster than that observed with synthetic wastewater (with similar CN concentration). A combined application of H(2)O(2)/O(3) was found to be the best option for maximum CN destruction. This treatment allows CN to reach the regional/international limit (of 0.02 mg/L) for safe industrial wastewater discharges to the receiving water bodies. The specific energy consumption by the photoreactor following this treatment was comparable to that obtained by conventional treatments, which use photocatalyst. Since the present treatment does not use catalyst, it provides an excellent energy efficient and economical option for treatment and safe disposal of CN containing industrial wastewater.

**Assaying baseline status of particulate laden polyaromatic hydrocarbon for a grass root level industrial project.**

[Pandya GH, Chatterjee N, Singh R, Kashyap S, Pentu Saheb S, Wate SR. Bull Environ Contam Toxicol. 2009 Feb;82(2):185-8.]

A study of particulate laden polyaromatic hydrocarbon was conducted at 13 selected locations in a 10 km radial distance of a proposed site for a grass root level industry.

Suspended particulate matter samples were continuously monitored for 24 h over a period of 3 months. The Polyaromatic Hydrocarbons (PAHs) were extracted from the particulate samples and analysed using Gas Chromatograph-Mass Spectrometer. Limit of Quantification was also established for individual PAHs. Coal combustion and traffic emission were the major contributors for PAHs in the region. The relative contribution of 2, 3, 4, 5, and 6 ring PAHs in particulates of different sampling sites was also investigated and it is observed that 4 ring (29.76%) and 5 ring (29.06%) compounds are prominent in the particulates measured in the region.

#### **Assessment of groundwater quality with respect to fluoride.**

[Salve PR, Maurya A, Kumbhare PS, Ramteke DS, Wate SR. Bull Environ Contam Toxicol. 2008 Sep;81(3):289-93.]

The study was conducted in the summer season (April-May 2007). The fluoride concentration along with physico-chemical parameters in ground water samples was determined in various villages of Kadi tehsil at Mehsana district of Gujarat state (India), since in most of the villages it is the only source of drinking water. The fluoride concentrations in these villages varied from 0.94 to 2.81 mg/L (1.37 $\pm$ 0.56) with highest fluoride level at Visalpur (2.08 mg/L) and lowest at Adaraj (0.91 mg/L). There was found a positive correlation of pH with fluoride and a negative relationship of fluoride with bicarbonate which is generally observed in deep ground water.

#### **Environmental impact assessment of the proposed Information Technology Park at Perungudi.**

Sharmilaa G. J Environ Sci Eng. 2007 Oct;49(4):325-32.

Environmental impact assessment studies of the proposed Information Technology Park at Perungudi have been carried out. The study involved assessing the existing environmental quality of the proposed site, and predicting impacts and preparing an environmental management plan. Data on the existing quality of water, soil, land use pattern, air, noise and socio-economic details of the proposed project were assessed. The impacts due to the proposed activity were identified and evaluated using the Network Impact Methodology. The water requirement was found to be 3,63,400 L/day. The total wastewater likely to be generated was found to be 2,90,720 L/day. The wastewater will be treated in a sewage treatment plant. The generation of solid waste was assessed to about 500 kg/day. Increase in traffic level was found out by traffic survey. The socio-economic environment will have a positive impact from the proposed project. An Environmental Management Plan was

prepared which includes the mitigation measures for improving the eco-profile of the study area.

#### **Quantification of transition metals in biological samples and its possible impact on ferro-alloy workers.**

[Mishra S, Ramteke DS, Wate SR. J Environ Biol. 2007 Oct;28(4):851-6.]

Increased risk of ill-health and diseases has been associated with employment in the ferro-alloy factory. Since measurement of transition metals in human blood and hair along with respective exposure rates, provides a means of assessing individual risk, it has been the most important part of the study. In the study majority of the elements in the transition series, such as, vanadium (V), chromium (Cr), iron (Fe), manganese (Mn), cobalt, (Co) nickel (Ni), copper (Cu), zinc (Zn), molybdenum (Mo) and cadmium (Cd) were considered which are randomly emitted from the source, that is, manganese ore (used during ferro-alloy manufacturing process). The commonly available transition, metals, observed in biological samples of ferro-alloy workers, were found to be Fe, Zn, Co, Ni, Cu, Cr, Cd, V Mn and Mo in blood, while in hair, Mn, Fe, Zn, Co, Ni, Cu, Cr, Cd, V and Mo were present in decreasing order. Surveillance of bio-concentration of these metals in workers, exposed to close proximity of the coke-ovens and smelting furnaces, revealed that the workers were prone to several physical disorders.

#### **Assessing impact of industrialization in terms of LULC in a dry tropical region (Chhattisgarh), India using remote sensing data and GIS over a period of 30 years.**

[Joshi PK, Kumar M, Paliwal A, Midha N, Dash PP. Environ Monit Assess. 2009 Feb;149(1-4):371-6.]

The main focus of the paper is to assess the land use/ land cover (LULC) change in northern Chhattisgarh due to industrialization using remote sensing and Geographical Information System (GIS). The impact was assessed using an information extraction method applied to temporal satellite data (LANDSAT and IRS scenes) in GIS domain. For assessing the impact on natural resources, the classification scheme was restricted to (1) Forest patches ((a) completely cleared, (b) partially cleared, (c) least affected), (2) Non-Forest ((d) completely changed, (e) least changed), (3) Industrial/Mining area, and (4) River. Over the three decades 22.22% of forests have been completely cleared and converted to industrial setup. Another 25% is completely cleared and 10% is degraded. Around 4% of agricultural area is totally affected due to industrial activity. Random assessment of plant distribution (Trees, Shrubs and Herbs) indicates significant changes in the herb distribution directly related

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to distance gradient from the industrial/mining setup. Visual recording, socio-economic survey and satellite data also helped in delineation of extent of environmental pollution in forest and non-forest areas. The paper presents methodology for the environmental impact assessment.

**Environmental impact assessment and seasonal variation study of the groundwater in the vicinity of River Adyar, Chennai, India.**

[Venugopal T, Giridharan L, Jayaprakash M, Periakali P. Environ Monit Assess. 2009 Feb;149(1-4):81-97.]

Hydrochemical investigations of the groundwater and the seasonal effect on the chemical budget of ions along the course of the polluted river Adyar were carried out. From the geochemical results, it has been found that the seasonal effect does not change the order of abundance of both cations and anions, but it does change the concentration of various ions present in the groundwater. Among the chemical budget of ions, sodium and chloride were found to be the most predominant ions. The nitrate concentration in the groundwater ranges from 4.21 to 45.93 mg/l in pre-monsoon and in post-monsoon it ranges from 1.02 to 75.91 mg/l. The nitrate concentrations in the post-monsoon are high in some places especially in the upper stretch of the river. The intense agricultural activities near the upper stretch of the river may be an important factor for the higher concentration of nitrates in these aquifers. In order to determine the geochemical nature of water, the data was interpreted using the piper diagram wherein the results show the predominance of NaCl and CaMgCl types. Equiline diagrams, 1:1, were applied to evaluate the affinity ion relationship between various ions present in these waters. The quality of the groundwater was assessed with regard to its suitability to drinking and irrigation. A comparison of the groundwater quality in relation to drinking water quality standards shows that most of the water samples are not suitable for drinking, especially in post-monsoon period. US Salinity Laboratory's, Wilcox's diagrams, Kelly's ratio and magnesium ratio were used for evaluating the water quality for irrigation which suggest that the majority of the groundwater samples are not good for irrigation in post-monsoon compared to that in pre-monsoon. Moreover the source of the ions in the water was examined and classified accordingly using Gibb's diagram. The analytical results reveals that the TDS values of the pre-monsoon samples were found to be lower than the post-monsoon reflecting that leaching predominates over that of the dilution factor.

**Influence of salinity on PAH Uptake from water soluble fraction of crude oil in *Tilapia mossambica*.**

[Shukla P, Gopalani M, Ramteke DS, Wate SR. Bull Environ Contam Toxicol. 2007 Dec;79(6):601-5.]

Accidents during marine transport and offshore production facilities often are responsible for oil spills in the open sea. In few cases, these oil slicks drift towards the shore and further into the estuaries, which serve as an important spawning and nursing grounds for many fish species. This study examined the role of salinity in the uptake and accumulation of toxic PAH from crude oil in select somatic and reproductive organs of *Tilapia mossambica*. Our results showed significantly (ANOVA,  $p < 0.01$ ) lower PAH solubility in higher salinity waters and its uptake by fish. The differences were largest with the low molecular weight (LMW) two (naphthalenes) and three (phenanthrene) ring compounds as compared with higher molecular weight (HMW) compounds such as pyrene (four ringed).

**Pharmacoenvironmentology--a component of pharmacovigilance.**

[Rahman SZ, Khan RA, Gupta V, Uddin M. Environ Health. 2007 Jul 24;6:20.]

According to WHO, Pharmacovigilance activities are done to monitor detection, assessment, understanding and prevention of any obnoxious adverse reactions to drugs at therapeutic concentration on animal and human beings. However, there is also a growing focus among scientists and environmentalists about the impact of drugs on environment and surroundings. The existing term 'Ecopharmacology' is too broad and not even defined in a clear manner. The term 'Pharmacoenvironmentology' seeks to deal with the environmental impact of drugs given to humans and animals at therapeutic doses.

**Biomonitoring of heavy metals by pollen in urban environment.**

[Kalbande DM, Dhadse SN, Chaudhari PR, Wate SR. Environ Monit Assess. 2008 Mar;138(1-3):233-8.]

Industrial development and consumption of petroleum products leads to increase air pollution levels especially in urban and industrial areas. Heavy metal components associated with air pollutants have far reaching effects with respect to economic and ecological importance of pollens. The pollens are male reproductive organs of the plant and travel through air from flower to flower for pollination purpose. During this period they are exposed to air pollutants. Present investigation thus pertains to study of effect of air pollutants on pollens especially biosorption and bioaccumulation of heavy metals. The pollens of three commonly occurring plants namely *Cassia siamea*, *Cyperus rotundus*, *Kigelia pinnata* have been studied from the NH-6 of Nagpur city, India. The pollens exposed to polluted air showed the presence of

higher concentrations of Ca, Al and Fe as compared to unexposed pollens. Higher concentration of these metals was observed in *Cyperus rotundus* followed by *Cassia siamea* and *Kigelia pinnata*. These results indicate that pollens act as good indicator of air pollution giving results in short time of exposure of 5-10 h. Apart from this, it is also reported that some of these metals play crucial role in the metabolic activity in pollens for example Calcium is necessary for growth of pollen tube and other metabolic activities in pollens. The presence of these metals in pollens may also enhance the allergenicity of the pollens. Similarly accumulation of heavy metals may also deteriorate the quality of pollen for their economical use. The viability of pollen is also affected by these pollutants in sensitive species leading to impairment of their fertility.

#### **Monitoring of environmental parameters for CO<sub>2</sub> sequestration: a case study of Nagpur City, India.**

[Chaudhari PR, Gajghate DG, Dhadse S, Suple S, Satapathy DR, Wate SR. Environ Monit Assess. 2007 Dec;135(1-3):281-90.]

Carbon dioxide concentration is an index of total amount of combustion and natural ventilation in an urban environment and therefore required more careful attention for assessment of CO<sub>2</sub> level in air environment. An attempt was made to monitor CO<sub>2</sub> levels in ambient air of Nagpur city at industrial, commercial and residential sites. In addition to this a remote sensing studies and biotic survey for floral biodiversity were carried out to study the green cover at respective sampling locations. The observations showed that the largest amount of CO<sub>2</sub> occurred at night due to absence of photosynthesis and lowest concentration of CO<sub>2</sub> was observed in the afternoon due to photosynthesis at its maximum level. The most pollution tolerant species found in Nagpur city are having higher Air Pollution Tolerance Index (APTI) value, which acts as a natural sink for CO<sub>2</sub> sequestration. In case of commercial site the CO<sub>2</sub> level is highest (366 ppm) because of lowest vegetation and vehicular pollution. The generation of database of CO<sub>2</sub> concentration and floral biodiversity along with percentage of green cover helps to formulate the strategy for prevention of global warming phenomenon.

#### **Assessing spatial occurrence of ground level ozone around coal mining areas of Chandrapur District, Maharashtra, India.**

[Salve PR, Satapathy DR, Katpatal YB, Wate SR. Environ Monit Assess. 2007 Oct;133(1-3):87-98.]

Stratospheric input and photochemical ozone formation in the troposphere are the two main sources determining the ozone levels in the surface layer of the atmosphere.

Because of the importance of ozone in controlling the atmospheric chemistry and its decisive role in the heat balance of atmosphere, leading to climate change, the examination of its formation and destruction are of great interest. This study characterized the distribution of Ground level Ozone (GLO) in Chandrapur district is lying between 19 degrees 25'N to 20 degrees 45'N and 78 degrees 50'E to 80 degrees 10'E. Continuous ozone analyzer was used to quantify GLO at thirteen locations fixed by Global Positioning System (GPS) during the winter of 2005-2006. The daily GLO at all the locations ranged between 6.4 and 24.8 ppbv with an average and standard deviation of 14.9 +/- 6.5 ppbv. The maximum and minimum concentration occurs during 1300-1600 h and 0300-0500 h may be due to high solar radiation facilitating photochemical production of O<sub>3</sub> and downward mixing from the overlying air mass and in situ destruction of ozone by deposition and/or the reaction between O<sub>3</sub> and NO. GIS based spatial distribution of GLO in Chandrapur district indicates that the central core of the district and southern sites experienced elevated levels of GLO relative to the northern and western areas. The sites near by Chandrapur city are particularly affected by elevated GLO. The average variation of GLO with temperature shows a significant correlation of  $r = 0.55$  indicating a direct relationship between GLO and temperature. Similarly an attempt has been made to compare the GLO monitored data in Chandrapur district with the reported values for other locations in Indian cities. This generated database helps regulatory agencies to identify locations where the natural resources and human health could be at risk.

#### **Adsorption of malachite green on groundnut shell waste based powdered activated carbon.**

[Malik R, Ramteke DS, Wate SR. Waste Manag. 2007;27(9):1129-38.]

In the present technologically fast changing situation related to waste management practices, it is desirable that disposal of plant waste should be done in a scientific manner by keeping in view economic and pollution considerations. This is only possible when the plant waste has the potential to be used as raw material for some useful product. In the present study, groundnut shell, an agricultural waste, was used for the preparation of an adsorbent by chemical activation using ZnCl<sub>2</sub> under optimized conditions and its comparative characterisation was conducted with commercially available powdered activated carbon (CPAC) for its physical, chemical and adsorption properties. The groundnut shell based powdered activated carbon (GSPAC) has a higher surface area, iodine and methylene blue number

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compared to CPAC. Both of the carbons were used for the removal of malachite green dye from aqueous solution and the effect of various operating variables, viz. adsorbent dose (0.1-1 g l<sup>-1</sup>), contact time (5-120 min) and adsorbate concentrations (100-200 mg l<sup>-1</sup>) on the removal of dye, has been studied. The experimental results indicate that at a dose of 0.5 g l<sup>-1</sup> and initial concentration of 100 mg l<sup>-1</sup>, GSPAC showed 94.5% removal of the dye in 30 min equilibrium time, while CPAC removed 96% of the dye in 15 min. The experimental isotherm data were analyzed using the linearized forms of Freundlich, Langmuir and BET equations to determine maximum adsorptive capacities. The equilibrium data fit well to the Freundlich isotherm, although the BET isotherm also showed higher correlation for both of the carbons. The results of comparative adsorption capacity of both carbons indicate that groundnut shell can be used as a low-cost alternative to commercial powdered activated carbon in aqueous solution for dye removal.

#### Heavy metals in airborne particulate matter of urban Coimbatore.

[Mohanraj R, Azeed PA, Priscilla T. Arch Environ Contam Toxicol. 2004 Aug;47(2):162-7.]

Exposures to airborne metals are known to cause physiological responses in organisms and wide-ranging health effects in humans. Hence determination of metals in particulate matter is important from a toxicological perspective. In the current study heavy metals associated with respirable (RSPM) and nonrespirable (NRSPM) fractions of suspended particulate matter were estimated in air samples from six stations in Coimbatore, India, during March 1999 to February 2001. The mean quantity of heavy metals in RSPM was in the order Zn > Cu > Pb > Ni > Cr > Cd. Concentrations of these heavy metals were in the range of BDL (below detectable level) to 2,147 ng/m<sup>3</sup> in RSPM. The highest level of lead (2,147 ng/m<sup>3</sup>) was recorded at an industrial station. The station also had the highest mean value (481 +/- 544.3 ng/m<sup>3</sup>), suggesting the importance of industrial operations in determining the ambient concentrations of lead. Significant positive correlation among metals excepting lead and copper suggests that they originate mostly from a common source. Air samples of urban and industrial areas showed higher concentrations than residential (Urban) and suburban areas.

#### Regulation of nuclear radiation exposures in India.

[Mishra UC. J Environ Radioact. 2004;72(1-2):97-102.]

India has a long-term program of wide spread applications of nuclear radiations and radioactive sources for peaceful applications in medicine, industry, agriculture and research and is already having several thousand places in

the country where such sources are being routinely used. These places are mostly outside the Department of Atomic Energy (DAE) installations. DAE supplies such sources. The most important application of nuclear energy in DAE is in electricity generation through nuclear power plants. Fourteen such plants are operating and many new plants are at various stages of construction. In view of the above mentioned wide spread applications, Indian parliament through an Act, called Atomic Energy Act, 1964 created an autonomous body called Atomic Energy Regulatory Board (AERB) with comprehensive authority and powers. This Board issues codes, guides, manuals, etc., to regulate such installations so as to ensure safe use of such sources and personnel engaged in such installations and environment receives radiation exposures within the upper bounds prescribed by them. Periodic reports are submitted to AERB to demonstrate compliance of its directives. Health, Safety and Environment Group of Bhabha Atomic Research Centres, Mumbai carries out necessary surveillance and monitoring of all installations of the DAE on a routine basis and also periodic inspections of other installations using radiation sources. Some of the nuclear fuel cycle plants like nuclear power plants and fuel reprocessing involve large radioactive source inventories and have potential of accidental release of radioactivity into the environment, an Environmental Surveillance Laboratory (ESL) is set up at each such site much before the facility goes into operation. These ESL's collect baseline data and monitor the environment throughout the life of the facilities including the decommissioning stage. The data is provided to AERB and is available to members of the public. In addition, a multi-tier system of AERB permissions is in place to ensure that all aspects of safety have been considered before permission to operate is granted. The stages where permission of AERB is essential are site selection, design data, and several stages during construction and operation. The details required by AERB include provision for treatment and storage of radioactive waste, de-commissioning procedures and provision of costs. In addition to AERB, nuclear power plants have to comply with the requirements of Ministry of Environment and Forests and get their clearance. This is given on the basis of Environmental Impact Assessment Report which should satisfy the authorities that no ecological damage will be caused and the facility will not have adverse effect on the environment. In addition, the State Pollution Control Board where the facility is to be located has to permit the site of the plant for its proposed discharges into the environment. It is largely due to the above comprehensive regulatory controls that none of the plants in India had any



accident during the last 34 decades of operation. The type of measurements carried out by the ESL's and results from a few typical ESL's will be presented.

#### **Environmental impact of coal industry and thermal power plants in India.**

[Mishra UC. J Environ Radioact. 2004;72(1-2):35-40.]

Coal is the only natural resource and fossil fuel available in abundance in India. Consequently, it is used widely as a thermal energy source and also as fuel for thermal power plants producing electricity. India has about 90,000 MW installed capacity for electricity generation, of which more than 70% is produced by coal-based thermal power plants. Hydro-electricity contributes about 25%, and the remaining is mostly from nuclear power plants (NPPs). The problems associated with the use of coal are low calorific value and very high ash content. The ash content is as high as 55-60%, with an average value of about 35-40%. Further, most of the coal is located in the eastern parts of the country and requires transportation over long distances, mostly by trains, which run on diesel. About 70% oil is imported and is a big drain on India's hard currency. In the foreseeable future, there is no other option likely to be available, as the nuclear power programme envisages installing 20,000 MWe by the year 2020, when it will still be around 5% of the installed capacity. Hence, attempts are being made to reduce the adverse environmental and ecological impact of coal-fired power plants. The installed electricity generating capacity has to increase very rapidly (at present around 8-10% per annum), as India has one of the lowest per capita electricity consumptions. Therefore, the problems for the future are formidable from ecological, radio-ecological and pollution viewpoints. A similar situation exists in many developing countries of the region, including the People's Republic of China, where coal is used extensively. The paper highlights some of these problems with the data generated in the author's laboratory and gives a brief description of the solutions being attempted. The extent of global warming in this century will be determined by how developing countries like India manage their energy generation plans. Some of the recommendations have been implemented for new plants, and the situation in the new plants is much better. A few coal washeries have also been established. It will be quite some time before the steps to improve the environmental releases are implemented in older plants and several coal mines due to resource constraints.

#### **Numerical analyses of soft bottom invertebrates to diagnose the pollution in tropical coastal waters.**

[Harkantra SN, Rodrigues NR. Environ Monit Assess. 2004 Apr-May;93(1-3):251-75.]

Soft bottom benthic organisms especially polychaetes are known to adapt as r or k selected strategies to different gradients of pollution. This will result in changes of benthic community structure from that of normal structure. There are a number of techniques to assess the impact of pollution on benthic community structure. Hence, to test this hypotheses some of the univariate and multivariate techniques were applied to soft bottom macro-invertebrates data of coastal waters of Mangalore, central west coast of India, a hot-spot area. Univariate techniques such as Pearson Rosenberg Model (PRM), abundance biomass comparison curve (ABC), geometrical class distribution, dominance-diversity curve, benthic community structure indices and multivariate techniques such as cluster classification, multidimensional scaling (MDS) and principal component analysis (PCA) were used to discriminate and diagnose the disturbance among the sites. Effectiveness and applicability of some of the above techniques are highlighted and discussed with the present set of data for environmental impact assessment studies.

#### **Health impact assessment needs in south-east Asian countries.**

[Caussy D, Kumar P, Than Sein U. Bull World Health Organ. 2003;81(6):439-43.]

A situation analysis was undertaken to assess impediments to health impact assessment (HIA) in the South-East Asia Region of WHO (SEARO). The countries of the region were assessed on the policy framework and procedures for HIA, existing infrastructure required to support HIA, the capacity for undertaking HIA, and the potential for intersectoral collaboration. The findings show that environmental impact assessment (EIA) is being used implicitly as a substitute for HIA, which is not explicitly or routinely conducted in virtually all countries of the Region. Therefore, policy, infrastructure, capacity, and intersectoral collaboration need strengthening for the routine implementation of HIA.

#### **Industrial estate planning and management in India--an integrated approach towards industrial ecology.**

[Singhal S, Kapur A. J Environ Manage. 2002 Sep;66(1):19-29.]

Industrial estates (IE) are today perceived as an integral part of development strategies of many countries worldwide. The environmental impacts from a concentration of large number of industries in a small area or unplanned IE, can pose a serious threat to both local and global sustainable development initiatives. The formation of ecologically balanced industrial systems can result in numerous environmental and economic benefits. This paper examines the relevance of industrial symbiosis

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and carrying capacity concepts and proposes an integrated approach towards IE planning in India based on grouping combinations of industries based on carrying capacity, formation of green industrial townships, development of environmental impact assessment guidelines for IE and implementation of environmental management systems.

### **Identification and classification of key variables and their role in environmental impact assessment: methodology and software package INTRA.**

[Arya DS, Abbasi SA. Environ Monit Assess. 2001 Dec;72(3):277-96.]

There is, as yet, no proven methodology to enable, objectively, the identification of key parameters out of a large number one normally encounters during any EIA. As EIA is a costly and time-consuming exercise, it is necessary to separate the man from the boys--so to speak--in order to optimize costs and efforts. In this paper a methodology for distinguishing the more important parameters from the less important ones, developed by us, is described. The methodology aims at identifying and shortlisting the key parameters which ought to be studied in a given EIA situation, thereby helping in reducing time, effort, and cost of EIA. With this methodology a system structure is developed which gives hierarchical pattern of inter-parameter interaction, and reveals several distinguishing features of each parameter. A software package INTRA (INter-parameter Relationship Analysis)

based on this methodology, has been developed. The paper also describes a case study in which INTRA has been used to study the environmental impacts of urbanization of a typical third world town (Roorkee).

### **A note on the use of the analytic hierarchy process for environmental impact assessment.**

[Ramanathan R. J Environ Manage. 2001 Sep;63(1):27-35.]

Environmental impact assessment (EIA) is an intrinsically complex multi-dimensional process, involving multiple criteria and multiple actors. Multi-criteria methods can serve as useful decision aids for carrying out the EIA. This paper proposes the use of a multi-criteria technique, namely the analytic hierarchy process (AHP), for the purpose. AHP has the flexibility to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis. The main shortcomings of AHP and some modifications to it to overcome the shortcomings are briefly described. Finally, the use of AHP is illustrated for a case study involving socio-economic impact assessment. In this case study, AHP has been used for capturing the perceptions of stakeholders on the relative severity of different socio-economic impacts, which will help the authorities in prioritizing their environmental management plan, and can also help in allocating the budget available for mitigating adverse socio-economic impacts.

## RESEARCH DIGEST

### **Contrails Warm the Globe** Science, 27 June 2011



### **Voigt et al., Geophysical Research Letters, 38 (2011)**

The white, cloudy contrails airplanes often leave in the sky may be full of ice crystals, but they're warming the globe,

according to a new study. By flying in the wake of various aircraft—ranging in size from the 47-metric-ton Airbus A319 to the 508-metric-ton Airbus A380 (contrails of two Airbus A340s shown)—and analyzing their less-than-10-minute-old contrails, researchers have found that fresh contrails tend to trap outbound infrared radiation, slightly heating Earth. Based on 2005 air traffic figures such contrails, if their effect were to be evenly spread out across the globe, would continuously trap 15.9 milliwatts of power per square meter, the researchers report in *Geophysical Research Letters*. That's about 1% of the amount trapped by the carbon dioxide added to the atmosphere since the beginning of the Industrial Revolution.

### **West Africa's toxic problem: Ships' graveyard may be behind high levels of banned chemicals.**

Nature 20 January 2011

Researchers cruising off the western coast of Africa have

confirmed the presence of mysteriously high levels of airborne toxic polychlorinated biphenyls (PCBs). The production and use of these chemicals is now largely banned by national laws and under the 2001 Stockholm Convention on Persistent Organic Pollutants — because of worries over their potential for causing cancer and other health problems. The reason the levels detected off the West African coast are a surprise — and a cause for concern — is that this region has not previously figured highly in thinking about the pollutants. "We found high levels of PCBs in a region of the world where we wouldn't expect to find them," says Rosalinda Gioia, an atmospheric pollution researcher at Lancaster University, UK, and the lead author of the report of the high levels in *Environmental Science & Technology*. "In the global inventories of PCBs, Africa does not really represent a place where PCBs were sold or used," she says. "Of



course, the long-term exposure to these levels of PCBs could lead to adverse effects to human health; however, a detailed toxicological study is needed in order to determine the effects." Gioia says that action must now be taken to find and deal with the major West African sources of the pollutants. Illegal dumping and poor disposal of toxic waste — including a large ships' graveyard in Mauritania — are among the chief suspects.

#### Pollution problems

Although PCBs have a low immediate toxicity, they are very persistent in the environment and accumulate in tissues over time. Many African countries are developing inventories of their pollutants as part of their responsibilities under the Stockholm Convention, says Jana Klánová, who works on African pollution issues at the Research Centre for Toxic Compounds in the Environment at Masaryk University in Brno, in the Czech

Republic. The next step is to identify priority problems in each country and draw up plans to deal with them. "Although most researchers in Africa are concerned with organochlorine pesticides — especially DDT which is still used for malaria control — PCB contamination should not be overlooked," Klánová told *Nature*. "According to our long-term measurements, the atmospheric levels of PCBs at background sites in Africa are lower than in Europe, but the urban, and especially industrial, sites have the same PCB levels in Africa as they do in Europe."

#### PCB plume

Gioia's team first noticed something odd off West Africa on a 2001 research cruise, when they observed a spike in the concentration of seven of the most important PCBs — the so-called ICES set. They noticed a similar plume of high levels of PCBs during a 2005 cruise.

In 2007, aboard the German research vessel *Polarstern*, Gioia again observed the PCB plume some 400 kilometres off the West African coast. The spike in levels was most pronounced when the wind was blowing from the African coast out to sea. This time, rather than just report the concentrations of the pollutants, she and her colleagues tried to determine their sources. One possible source of PCBs is biomass burning, which is thought to release PCBs previously deposited in the soil. However, burning also produces another type of chemical called polynuclear aromatic hydrocarbons (PAHs). In the samples taken on the *Polarstern* cruise, PAHs were at their lowest when PCBs were highest, which argued against burning as a source.

Gioia says that one likely source of the pollution is the dumping of old electrical waste such as capacitors and other PCB-containing products. Developing countries take large amounts of waste from Western nations and break them down or dispose of them, often with little regard for safety or pollution. Another probable source of the PCBs is one of the world's largest ships' graveyards. Just south of Nouadhibou in Mauritania, hundreds of wrecks have been grounded in shallow water where they are scavenged or simply left to decay. This break-up probably releases PCBs, Gioia says. The precise sources of the PCB plume should be pinned down and used to complete the pollutant inventories of African countries, she says. These nations must then be helped to safely dispose of the potentially dangerous chemicals.

#### Arsenic sinks to new depths

Groundwater overuse can push poisonous element deeper — a serious risk for countries in Southern Asia.

*Nature* 17 January 2011

## RESEARCH DIGEST



More than a century of groundwater over-exploitation in Vietnam has drawn the water table down and, with it, arsenic. It may only be a matter of time before the toxic element also permeates deep aquifers in other Asian countries that follow the same practice, such as those around the Bengal Basin. These conclusions, published in the Proceedings of the National Academy of Sciences, point to high future costs in terms of both health and water-purification processes. Some 100 million people throughout Asia are currently at risk from unsafe levels of arsenic in their water supplies. The element can trigger conditions ranging from anaemia to skin cancer. With deeper aquifers so far thought to be arsenic-free, some municipal authorities in Bangladesh, and many in Vietnam, are drilling into lower sediments. In Vietnam, a nation that began overusing its deep aquifers under French occupation more than 110 years ago, the effect is already pronounced. In the region surrounding the densely populated city of Hanoi — with nearly 2,000 people per square kilometre — it is difficult to escape arsenic-contaminated water, no matter how deeply you drill. The researchers analysed 512 private tubewells reaching to depths ranging from 10 metres to more than 50 metres throughout the country's Red River Delta. Their findings revealed that 27% of the wells contained levels of arsenic in excess of the World Health Organization's standard of 10 micrograms per litre, says Michael Berg, a senior scientist at the Swiss Federal Institute of Aquatic Science and Technology in Dübendorf and a co-author on the study. This puts some 3 million people at risk.

The survey, carried out in cooperation with the Hanoi University of Science and Technology, also found harmful levels of other elements — about 7 million people in the Red River Delta are exposed to unsafe levels of at least one element. After arsenic, the most important of these is

manganese, which exceeded World Health Organization guidelines in 44% of the wells. Elevated levels of this element can affect neurological development in children.

### Mapping the depths

From the survey data, Berg's team created the first three-dimensional groundwater map, using statistical modelling to show levels that are relatively arsenic-free. "It is now clear where water is safe and where it is unsafe. That is one of the most important findings for the public," says Berg. The map makes it difficult for officials to ignore the arsenic problem, says Dieke Postma, a senior researcher at the Geological Survey of Denmark and Greenland, who has been working in the region since 2004 and is unconnected with the new study. "It's important for the Vietnamese authorities because they haven't had an overview of how big the problem is," he says.

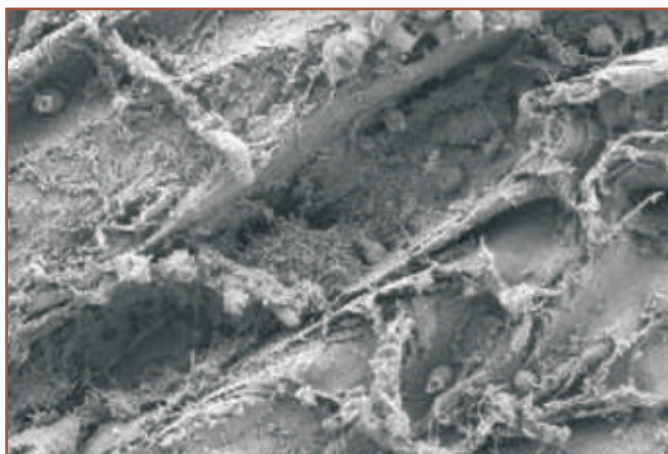
Postma says he hopes that an international scientific conference on the issue, to be held in Hanoi in November, will draw further official attention to arsenic contamination in the region. The implications of the finding could be serious for countries around the Bengal Basin in South Asia. In Bangladesh, where some 70 million people are exposed, the use of deep aquifers is a more recent phenomenon. Decades ago, aid agencies introduced tube wells as a reliable and clean water source, only to find that the top-most sediment layers, formed in the 12,000 years since the start of the current Holocene epoch, contain naturally occurring arsenic that leaches into the groundwater. To avoid contamination, wells in the Bengal Basin can be drilled into deep layers that were oxidized during the last ice age, in which the water is free of arsenic, Berg says. These aquifers were created during the Pleistocene epoch, between 12,000 and 2.5 million years ago, and lack the organic carbon that is needed for arsenic to leach into water. But if people in the Bengal Basin continue to exploit their water supplies at the current rates, arsenic-laden water from the upper layers may find its way into Pleistocene aquifers, the study suggests.

The group is the first to give real-life evidence that arsenic in deeper layers can get into groundwater. Other lab-based studies have suggested that sediments in deeper aquifers tend to keep arsenic out of the water, says William Burgess, a hydrogeologist at the Department of Earth Sciences at University College London. On the basis of the new study, he thinks that such sequestration may not always happen and probably depends on the composition of sediments and the complexity of water flow underground. "Pumping from the Pleistocene aquifer has

certainly had an adverse effect in terms of drawing down arsenic at significantly high concentrations over about 100 years," says Burgess. "These deep wells weren't being monitored 10, 20, 30 years ago, so we don't know how quickly arsenic got down there, but it got there sometime in the past 100 years."

**Marine microbes digest plastic: A 'little world' eating ocean garbage might be a mixed blessing.**

Nature 28 March 2011



Specialist bacteria seem to be eating the plastic garbage we throw into the ocean. But whether they're cleaning up our poisons or just passing them back up the food chain remains to be seen.

The ocean contains vast amounts of plastic, mostly as tiny shards floating just beneath the surface. Under an electron microscope, each scrap of "plastic confetti" becomes "an oasis, a reef of biological activity," says marine microbiologist Tracy Mincer of the Woods Hole Oceanographic Institution in Massachusetts. Mincer and his colleagues examined bits of fishing line, a plastic bag and a plastic nurdle (a pre-production plastic pellet) fished out of the Sargasso Sea, an area of the North Atlantic where currents cause debris to accumulate. The region as a whole contains more than 1,100 tonnes of plastic. Scanning electron microscopy revealed bacteria-like cells living in pits in the plastic, as if they were eating the surface away. "They look like you took a hot barbecue briquette and threw it into snow," says Mincer. "You see this melting bit all around the outside of the cells, and they're just burrowing into the plastic." Microbes have been found digesting plastic in landfills, he says, but this is the first evidence of marine bacteria breaking down plastic in the

ocean. The work was presented the 5th International Marine Debris Conference in Honolulu, Hawaii, on 24 and 25 March.

**Disappearing debris**

Plastic-eating bacteria might help explain why the amount of debris in the ocean has levelled off, despite continued pollution. But researchers don't yet know whether the digestion produces harmless by-products, or whether it might introduce toxins into the food chain. "To understand if it's a good thing or not, we have to understand the entire system," says Mincer. Plastics contain toxins such as phthalates, and also absorb additional toxic chemicals such as persistent organic pollutants from the ocean, says Mark Browne, an ecologist at University College Dublin in Ireland, who was not involved with the project. Those chemicals could leach out into the microscopic animals that eat the bacteria, or broken down microscopic plastic particles could enter cells and release their chemicals there, he says. "Whether or not that material then passes up the food chain is something of critical importance," he says. "It's yet another mechanism for the particles of plastic that we throw away to potentially come back to haunt us."

**Plastic lovers**

Genetic analysis shows that the bacteria on the plastic differ from those in the surrounding seawater or on nearby seaweed, says microbiologist Linda Amaral-Zettler of the Marine Biological Laboratory, Woods Hole. So far, the DNA sequences obtained by her lab show that almost 25% of the bacteria on one polyethylene surface were vibrios, bacteria from the same group as the cholera bacterium.

"That was a surprise, because normally in sea water they would be present in much lower concentrations," says Amaral-Zettler, who adds that she can't yet tell if these strains are pathogenic. Wind and ocean currents carry plastic all over the world, so no part of the sea will escape the effects of this bacterial activity. Amaral-Zettler and Mincer also found genetic and microscope evidence of eukaryotes — organisms with more complicated cells than bacteria — on the plastic. What she calls the "plastisphere" might contain complex living communities. "It may be a little world that we've created, for better or worse." The Wood's Hole scientists aim to sample more ocean plastic and to isolate, culture and identify the microbes found on it. Then they can determine if and how they're digesting the plastic and discover what the by-products are.

## RESEARCH DIGEST

**Thyroid Dysfunction as a Mediator of Organochlorine Neurotoxicity in Preschool Children**

Environ Health Perspect 30 June 2011.

Exposure to organochlorine compounds can alter thyroid function in humans, and hypothyroidism during early life can adversely affect a child's neurodevelopment. This study aims to assess the relationship between developmental organochlorine exposures and thyroid function, and the relationship between thyroid function and subsequent neurodevelopment. A population-based birth cohort of 182 children was followed annually up to five and a half years of age. The assessments included organochlorine compound concentrations in maternal pregnancy serum and milk, clinical thyroid parameters in maternal and cord serum, and subsequent neuropsychological outcomes of the child, along with socio-demographic cofactors. Resin-triiodothyronine uptake ratio was also assessed as an estimate of the amount of thyroxine binding globulin sites unsaturated by thyroxine. The resin-triiodothyronine uptake ratio is high in hyperthyroidism and low in hypothyroidism. The findings showed consistent, inverse and monotonic associations between organochlorine exposure and resin-triiodothyronine uptake ratio after covariate adjustments. No associations were observed with other thyroid parameters. Resin-triiodothyronine uptake ratio was positively associated with improved performance on most of the neuropsychological tests. For other thyroid parameters, the findings were less consistent. The results suggest that organochlorine compound exposures may decrease the resin-triiodothyronine uptake ratio during early life, which is a proxy measure of the binding capacity of thyroxine binding globulin. In addition, minor decreases of the thyroid function may be inversely associated with a child's neurodevelopment.

**Maternal Exposure to Air Pollution and Birth Outcomes**

Environ Health Perspect 119:553–558 (2011).

The knowledge about air pollution effects on birth weight, prematurity, and small for gestational age (SGA) in low-exposure areas is insufficient. The aim of this birth cohort study was to investigate whether low-level exposure to air pollution was associated with prematurity and fetal growth and whether there are sex-specific effects. We combined high-quality registry information on 81,110 births with individually modeled exposure data at residence for nitrogen oxides (NOx) and proximity to roads with differing traffic density. The data were analyzed by logistic and

linear regression with and without potential confounders. We observed an increased risk for babies being SGA when we compared highest and lowest NOx quartiles, adjusting for maternal age, smoking, sex, and year of birth. After additional adjustment for maternal country of origin and parity (which were highly intercorrelated), the increase was no longer statistically significant. However, in subgroup analyses when we compared highest and lowest NOx quartiles we still observed an increased risk for SGA for girls [odds ratio (OR) = 1.12; 95% confidence interval (CI), 1.01–1.24]; we also observed increased risk among mothers who had not changed residency during pregnancy (OR = 1.09; 95% CI, 1.01–1.18). The confounders with the greatest impact on SGA were parity and country of origin. Concerning prematurity, the prevalence was lower in the three higher NOx exposure quartiles compared with the lowest category. For future studies on air pollution effects on birth outcomes, careful control of confounding is crucial.

**Acrolein and Neuro Disorders**

Environ Health Perspect 119:a68-a68. doi:10.1289/ehp.119-a68a

Neurologic disorders are among the leading causes of death and illness in the United States. Their causes are poorly understood, but one of the emerging suspected culprits is the substance acrolein, which tends to be significantly elevated in the brains or spinal cords of people who have Alzheimer disease, Parkinson disease, amyotrophic lateral sclerosis (ALS), and other neurologic disorders.<sup>1–4</sup> A new study adds multiple sclerosis (MS) to the list of disorders potentially affected by this substance. Acrolein is produced naturally in the body as a by-product of membrane lipid peroxidation. It also occurs in combustion by-products such as vehicle exhaust, industrial emissions, oil- and coal-fired power plant emissions, cooking fumes, and the smoke from burning cigarettes, wood, and plastics. It's used as a biocide and to manufacture other chemicals and products such as chemical weapons. The U.S. Environmental Protection Agency (EPA) has determined the ubiquitous pollutant is a major source of respiratory damage. But information on the neurologic effects of environmental acrolein is scant. In the new study, Riyi Shi of Purdue University and colleagues injected mice with substances known to induce experimental autoimmune encephalomyelitis, an animal model for MS. Within 2 weeks acrolein-lysine adduct levels in the spinal cord began to rise, peaking at 65% higher than in controls at about day 20. At the same

time, the mice began to display significant muscle control problems. Treatment with the acrolein-scavenging substance hydralazine reduced those effects to a great although not significant degree. The researchers also detected significant mitigation of damage to the myelin sheath by hydralazine. Shi and colleagues say their study provides the first evidence that endogenous acrolein plays a key role in MS. Shi says it's plausible that environmental acrolein can act in the same general way: "There's no reason not to believe that the same type of damage could occur." Richard LoPachin, a neurochemist and director of research at Montefiore Medical Center in New York, partially agrees. "Because acrolein is highly reactive with proteins at the site of exposure, it has limited distribution in the body and, therefore, limited access to the brain," he says. But acrolein is just one of many type-2 alkenes, a large family of

environmental and food contaminants that includes acrylamide, methyl vinyl ketone, methyl acrylate, and 4-hydroxynonenal. LoPachin says type-2 alkenes share a common mechanism of action at nerve terminals in the brain, and he thinks the combined effects of these substances could contribute to some neurologic disorders. Robert Kavlock, director of the EPA National Center for Computational Toxicology, says acrolein's physical properties make it difficult to assess the compound using the agency's ToxCast™ high-throughput chemical screening program using currently available technology. But pinning down the causes of these neurologic disorders could help millions of people. In the United States alone, about 5.3 million people have Alzheimer disease, about 1.5 million have Parkinson disease, about 400,000 have MS, and about 30,000 have ALS.

## हिन्दी भाषा खण्ड

### कुछ जानकारियाँ

#### नींद खराब करती है शराब



ऐसा अक्सर कहा जाता है कि सोने से पहले एक पेग व्हिस्की लेने पर नींद बहुत अच्छी आती है। लेकिन शोधकर्ताओं की मानें तो यह आपकी नींद खराब करता है। डेली ऐक्सप्रेस में प्रकाशित खबर के अनुसार, जापान की एकिता यूनिवर्सिटी के नेतृत्व में एक अंतरराष्ट्रीय दल ने अपने शोध में पाया कि सोने से पहले शराब पीने से मनुष्य इंसोमेनिया का शिकार हो सकता है, इंसोमेनिया एक बीमारी है जिसमें मनुष्य को नींद नहीं आती उन्होंने पाया कि सोने से पहले शराब लेने से नींद में कमी आती है मनुष्य को इससे ज्यादा थकान महसूस होने लगती है।

दल का नेतृत्व कर रहे डॉक्टर योहेई सागवा ने कहा, सोने से पहले शराब पीने से अच्छी नींद नहीं आती है बल्कि आप इंसोमेनिया के शिकार हो सकते हैं। शोध का परिणाम 'एल्कोहलिज्म क्लिनिकल एण्ड एक्सपेरिमेंटल रिसर्च' जर्नल में प्रकाशित हुआ है।

#### सोने से कैंसर का इलाज

आसमान छूता सोने का अब कैंसर के इलाज में भी उपयोग होगा ऐसा शोध से पता चला है।

वेस्टर्न ऑस्ट्रेलिया विश्वविद्यालय और ग्राफिट विश्वविद्यालय की अगुवाई में एक अंतरराष्ट्रीय दल ने छाया तकनीक की

मदद से बताया कि कैसे सोने का इस्तेमाल कीमोथैरेपी में किया जा सकता है। 'मेटालॉमिक्स' जर्नल में प्रकाशित अध्ययन में बताया गया कि वैज्ञानिकों ने कोशिकाओं पर सोने के प्रभाव की पड़ताल की।

अध्ययन दल के अमुवा का दावा है कि अयान मॉस स्पेक्ट्रोमेट्री की मदद से उपकोशकीय स्तर पर सोने से इलाज को कारगर पाया गया।



#### बाल अब नहीं होंगे सफेद, बल्ले-बल्ले

सफेद बाल अब शायद कुछ दिनों में गुजरे जमाने की बात बन सकते हैं। वैज्ञानिकों ने दावा किया है कि उन्होंने उस प्रोटीन की खोज की है जो बालों में रंगों को बरकरार रखता है। कई प्रयोगों के बाद न्यूयार्क विश्वविद्यालय के लांगोन मेडिकल सेंटर के वैज्ञानिकों के एक दल ने बालों में रंग भरने के लिए जिम्मेदार प्रोटीन 'डब्ल्यूएनटी' की पहचान की है। डेली मेल की खबर के मुताबिक इस खोज के बाद उन दवाओं, लोशनों, शैंपूओं की संभावनाएं पैदा हुई हैं जिनसे डब्ल्यूएनटी स्तर बढ़ेगा और सफेद बाल अपने प्राकृतिक रंग में लौट आएंगे। वैज्ञानिकों ने अपने प्रयोगों के माध्यम से यह बताया है कि यह प्रोटीन रासायनिक क्रियाएं शुरू करता है। जिससे सिर की त्वचा में स्टेम कोशिकाएं बड़ी होती हैं और वर्णक पैदा होते हैं। इसी वर्णक (पिगमेंट) से बाल में रंग भरता है।





### बिगड़ रही है समुद्र की सेहत

धरती के जलस्रोत समुद्र की सेहत लगातार तेजी से बिगड़ रही है। लगातार बढ़ रहे प्रदूषण समुद्रों से बड़ी मात्रा में मछली पकड़ने और इंसानों द्वारा खड़ी की गयी अन्य परेशानियों के कारण धरती के जल स्रोत समुद्रों की सेहत अनुमान से कहीं ज्यादा तेजी से बिगड़ रही है।

हाल ही में आयी एक नयी रिपोर्ट में वैज्ञानिकों ने यह बात कही है। वैज्ञानिकों के एक वरिष्ठ पैनल की रिपोर्ट के मुताबिक, कई कारण एक साथ मिलकर समुद्र की सेहत को खराब कर रहे हैं। पैनल अपनी यह रिपोर्ट संयुक्त राष्ट्र संघ को सौंपने वाला है। इस कारणों में समुद्र से बड़ी मात्रा में मछली पकड़ने के अलावा कार्बनडाईऑक्साइड की मात्रा बढ़ने से पानी की अम्लीयता बढ़ना, समुद्री जीवों के प्राकृतिक



निवास का बरबाद होना तथा समुद्री बर्फ का पिघलना शामिल है। इंटरनेशनल यूनियन फॉर कंजरवेशन ऑफ नेचर में वैश्विक समुद्री कार्यक्रमों के निदेशक कार्ल लुंडीन का कहना है, "चीजें कई स्तर पर खराब हो रही हैं।" इन्हीं के दल ने समुद्री जीवन पर यह रिपोर्ट तैयार की है। कार्ल ने एक साक्षात्कार में कहा कि हम इन परेशानियों के कारण कई समुद्री जीवों को हमेशा के लिए खो रहे हैं। उन्होंने हिंद महासागर में मौजूद 1,000 वर्ष पुराने प्रवाल की मौत को बेहद अविशनीय बताया। रिपोर्ट के अनुसार, "अगर हम ऐसे ही अपनी समुद्री जीवों को खोते रहे तो महज एक पीढ़ी के भीतर ही 'कोरल रीफ (प्रवाल) की जाति' पूरी तरह खत्म हो जाएगी।

### बीयर पीने वालों पर मेहरबान मच्छर

बीयर प्रमियों को शायद ये ना पता हो कि मच्छर इसकी दुर्गंध से अधिक आकर्षित होते हैं और वो उन्हें ज्यादा काटते हैं। मच्छरों को पता है कि इसका सेवन कर चुके लोग काटने पर प्रतिरोध कम करते हैं। वैज्ञानिकों ने पाया है कि अगर आपने अल्कोहल का सेवन कर रखा है तो मच्छर और अन्य कीड़े आपकी ओर 15 प्रतिशत ज्यादा आकर्षित होते हैं। फ्रांस की आई.आर.डी. अनुसंधान केन्द्र में वैज्ञानिकों की एक टीम ने पाया है कि अल्कोहल के सेवन से सांसों की गंध की ओर कीड़े ज्यादा आकर्षित होते हैं। वैज्ञानिकों का मानना है कि मच्छरों ने शराब की दुर्गंध को पहचानना सीख लिया है, क्योंकि इसका सेवन कर चुके लोग काटने पर प्रतिरोध कम करते हैं। एक रिपोर्ट के अनुसार इस अध्ययन से मलेरिया से बचाव किया जा सकेगा जिससे दुनिया भर में 780000 लोगों की मौत हो जाती है। अनुसंधानकर्ताओं ने इस अध्ययन का परिक्षण अफ्रीका में 2500 ऐनाफीलिस मच्छरों पर किया। उन्होंने 20 से 43 वर्ष के 25 लोगों को चुना और उनको स्थानीय शराब पिलाई। उन्होंने पाया कि उनकी ओर 15 प्रतिशत ज्यादा मच्छा उड़े थे। एक जर्नल में उन्होंने कहा कि बीयर के सेवन से अफ्रीका में मलेरिया के मुख्य कारक ऐनाफीलिस गैम्बी ज्यादा आकर्षित होते हैं।

## हिन्दी भाषा खण्ड

दूसरे तरफ बीयर पीने से कभी भी पथरी नहीं निकलती और न ही उससे खून साफ होता है। उन्टा बीयर में पाया जाने वाला अल्कोहल कई बीमारियों को शिकार बनाता है। हां, इसमें कोई शक नहीं है कि ज्यादा बीयर पीने से ज्यादा पेशाब आता है। इससे कई तरह के पदार्थ हमारे शरीर से बाहर निकल जाते हैं, लेकिन भ्रम के शिकार लोगों को यह पता होना चाहिए कि बीयर में ऑर्गजलेट व यूरिक अम्ल की मात्रा अधिक होती है। उसका स्वास्थ्य पर अच्छा असर नहीं पड़ता है।



### 'सुपर सैंड' से छानिये पानी

पीने का साफ पानी बड़ी समस्या है, वैज्ञानिकों ने इससे निपटने के लिए विशेष किस्म की बालू 'सुपर सैंड' तैयार की है। वॉशिंगटन से प्राप्त एक खबर के अनुसार भारतीय मूल के एक शोधकर्ता के नेतृत्व में वैज्ञानिकों के एक दल ने एक विशेष किस्म के बालू 'सुपर सैंड' तैयार की है। इन वैज्ञानिकों का दावा है कि इससे पानी को बहुत आसानी से और तेजी से छाना जा सकता है। वैज्ञानिकों का कहना है कि इस तकनीक के जरिए विकासशील देशों में हर साल लाखों लोगों की जान बचाई जा सकती है। सैकड़ों सालों से पानी को साफ रखने के लिए बालू का इस्तेमाल होता आया है, यहां तक कि विश्व स्वास्थ्य संगठन ने भी बालू को पानी छानने का कारगर और सस्ता उपाय माना है। मोनाश यूनिवर्सिटी के डॉक्टर मैनाक मजुमदार और उनकी अंतरराष्ट्रीय टीम ने बालू के फिल्टर



करने के प्राकृतिक गुण को कई गुना बढ़ा दिया है। इसके लिए उन्होंने ग्रेफाइट ऑक्साइड नामक एक नैनोमैटीरियल का इस्तेमाल किया। उन्होंने पाया कि बालू पर ग्रेफाइट ऑक्साइड की एक परत चढ़ा देने पर उसकी पानी छानने की क्षमता पांच गुना बढ़ जाती है। 'एसीएस एप्लाइड मैटीरियल्स एण्ड इंटरफेसेज' में प्रकाशित इस रिपोर्ट में कहा गया है कि सामान्य बालू 10 मिनट तक छानने के बाद संतृप्त हो जाता है जबकि ग्रेफाइट ऑक्साइड की परत वाला 'सुपर सैंड' 50 मिनट से अधिक समय तक पानी छान सकता है और प्रदूषकों को स्वयं शोषित कर सकता है।' डॉक्टर मजुमदार का कहना है कि सुपर सैंड का सबसे बड़ा फायदा यह है कि यह बहुत सस्ता है।

### टूटे सीएफएल असुरक्षित

टूटे हुए कॉम्पैक्ट फ्लोरोसेंट लाइट (सीएफएल) बल्ब इंसान के लिए असुरक्षित है। इनसे निकलने वाला मक्युरी हफ्तों तक हवा में घुलता रहता है। एक सीएफएल से निकलकर हवा में घुलने वाला लीक्विड मक्युरी (एचजी) हालांकि इंसान के लिए खतरनाक नहीं है लेकिन एक साथ अगर कई सीएफएल टूटे हुए पड़े हों तो इससे खतरा हो सकता है। जैक्सन स्टेट यूनिवर्सिटी के याडोंग ली और ली जिन के शोध के मुताबिक एक टूटे हुए सीएफएल से निकलने वाला लीक्विड बेपर की कुल मात्रा कभी-कभी सुरक्षित मात्रा को पार कर सकती है। जिससे इंसान को खतरा हो सकता है। टूटे हुए सीएफएल से निकलने वाले



मक्यूरी बेपर सांसों के माध्यम से इंसान के शरीर में प्रवेश करते हैं, ऐसे में टूटने के बाद इन्हें जल्द से जल्द हटाया जाना जरूरी है। साथ ही साथ इसके सम्पर्क में आए व्यक्ति को किसी हवायुक्त स्थान पर ले लाया जाना भी जरूरी है। जैक्सन के बयान में कहा गया है कि विभिन्न प्रकार के सीएफएल बल्बों से अलग-अलग मात्रा में मक्यूरी बेपर निकलता है और इसका मानव शरीर पर उसी अनुसार असर पड़ता है।

### पानी को शुद्ध करेगा बैक्टीरिया

प्राकृतिक तौर पर पाया जाने वाला बैक्टीरिया जहरीले पानी

को शुद्ध करने में मदद करता है। ऐसा दावा शोधकर्ताओं ने किया है। यूनिवर्सिटी ऑफ न्यू साउथ वेल्स के वैज्ञानिकों ने प्रदर्शित किया है कि पीवीसी प्लास्टिक उत्पादन के बाद भूजल में पैदा हुए औद्योगिक विषाक्त पदार्थों को प्राकृतिक तौर पर पाया जाने वाला बैक्टीरिया नष्ट कर सकता है। इस प्रयोग ने कई साल पहले एक रसायन संयंत्र से लीक हुए



रसायनों को नष्ट करने की बैक्टीरिया की प्राकृतिक योग्यता साबित कर दी है।

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Any feedback on this publication is welcome  
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