

Terrestrial and Aquatic Environmental Toxicology

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Scope and target readership: *Terrestrial and Aquatic Environmental Toxicology* provides up-to-date information on the latest advances in toxicology, modeling and quantitative assessment of environmental problems and will provide rapid publication of significant advances and discoveries in the fields of air, soil, water, and food contamination and pollution as well as articles on methodology and other disciplines concerned with the introduction, presence and effects of toxicants in the total environment. Equal weighting will be given to microbial and phytoremediation in the conservation of natural resources, the protection of habitats and the control of hazards.

Topics of relevance and interest include:

- 1) Behaviour, prevention, treatment and control of mineral, organic and radioactive pollutants;
- 2) Biochemistry of biodegradative pathways;
- 3) Biotransformation, mineralization, detoxification, recycling, amelioration or treatment of chemicals or waste materials by naturally-occurring microbial strains, microbial associations, or recombinant organisms;
- 4) Economic and legal aspects of biological treatment of waste;
- 5) Ecotoxicology and risk assessment;
- 6) Effects of chemicals and mechanisms of toxicity;
- 7) Enhancement of naturally-occurring biodegradative properties and activities;
- 8) Environmental processes and modeling;
- 9) Environmental technologies, remediation and control;
- 10) Environmental analytical chemistry, biomolecular tools and tracers e.g. stable isotopes;
- 11) Forensic toxicology;
- 12) Genetics of biodegradative organisms and the development of recombinant biodegrading organisms;
- 13) Green chemistry, environmentally friendly synthetic pathways, and alternative fuels;
- 14) Interfacial studies involving media such as soil, sediment, water, air, organism, and food;
- 15) *In vitro* systems for assessing or predicting the toxic effects of chemicals and elucidating their mechanisms of action. These *in vitro* techniques include utilizing cell or tissue cultures, isolated cells, tissue slices, subcellular fractions, transgenic cell cultures, and cells from transgenic organisms, as well as *in silico* modelling. use of methods in high-throughput toxicology and pharmacology; elucidation of mechanisms of toxic action; the application of genomics, transcriptomics and proteomics in toxicology, as well as on comparative studies that characterise the relationship between *in vitro* and *in vivo* findings in the areas of food components cosmetics, pharmaceuticals, pesticides, and industrial chemicals;
- 16) Management of solid and hazardous wastes, control of air pollution, and environmental conservation;
- 17) Molecular biology-based studies of biodegradative microbial communities, including metagenomic approaches (examinations of whole-community genomes);
- 18) Novel applications of biodegradation and biotransformation technology, e.g. to soil, water, sewage, heavy metals and radionuclides, organohalogenes, high-COD wastes, straight-, branched-chain and aromatic hydrocarbons;
- 19) Toxic activities at the molecular level, in humans and experimental animals;
- 20) Toxicokinetics;
- 21) Weed management and control methodologies, herbicide behaviors in plants, soils and environment, utilization of weeds and other aspects of weed science.

Terrestrial and Aquatic Environmental Toxicology does not publish routine case studies or results of biotreatment demonstrations that do not present new concepts or novel observations.

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Cover figure: Soil chemistry of EDTA (Manouchehri and Bermond, pp 1-15).

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Number 1

Nastaran Manouchehri, Alain Bermond (France) EDTA in Soil Science: A Review of its Application in Soil Trace Metal Studies (pp 1-15)

ABSTRACT

Invited Review: A comprehensive review is presented on the use of EDTA (ethylenediaminetetraacetic acid) in various fields of environmental geochemistry. The existing literature has been synthesized, analysed and discussed in terms of merits and disadvantages of the use of EDTA in remediation, fractionation and bioavailability prediction focusing on various key issues surrounding different environmental methodologies. Up-to-date information by different workers in various environmental scenarios explaining possible discrepancies are also being outlined.

Rupinder Kaur, Renu Bhardwaj, Ashwani Kumar Thukral (India) Interactive Effects of Cr(VI) with Other Heavy Metals on the Growth and Metal Uptake Potential of *Brassica juncea* L. Seedlings (pp 16-27)

ABSTRACT

Original Research Paper: The study was undertaken to assess the suitability of *Brassica juncea* L. cv. 'PBR-91' for phytoremediation of multi-heavy element contaminated soils. Growth and heavy metal uptake potential of *B. juncea* seedlings were determined in binary combinations of Cr(VI) with Mn, Ni, Co, Cu and Zn at concentrations varying up to 100 mg/l. Multiple regression interaction models revealed that all the metals, whether applied singly or in combinations, inhibited the growth of seedlings. In a single metal treatment, Cr(VI) (100 mg/l) decreased the germination percentage, root length, shoot length and dry weight to the maximum extent. The interactive effects of binary combinations of Cr(VI) with other metals were generally mutually antagonistic and decreased the toxicity of each other on seedling growth. The maximum uptake was recorded for 100 mg/l each of Zn and Mn, being 0.531 and 0.445 mg/g dw, respectively. The lowest heavy metal uptake was observed for Ni (0.135 mg/g dw) at a concentration of 100 mg/l. Multiple regression interaction models also revealed that the interaction between Cr and the other metals in binary combinations decreased the uptake of Cr by seedlings. This study established that Zn and Mn significantly reduce the deleterious effects of Cr(VI) on seedling growth in *B. juncea*.

Md. Kawser Ahmed, Dipa Rani Biswas, Md. Monirul Islam, Mosammat Salma Akter, Azizul Islam Kazi, Gazi Nurun Nahar Sultana (Bangladesh) Heavy Metal Concentrations in Different Organs of Fishes of the River Meghna, Bangladesh (pp 28-32)

ABSTRACT

Original Research Paper: The objective of this study was to observe heavy metal (As, Pb, Cr, Ni, Hg and Cd) contamination in different organs (liver, intestine, gill, scale and muscle from different portions of body as well as whole body) of three fish species (*Channa striatus*, *Glossogobius giuris* and *Clupisoma garua*) of the river Meghna. Pb was highly concentrated among all the measured heavy metals in different organs of fishes. Cumulative mean concentrations of heavy metals in different organs of the studied fishes were observed in the order: liver > intestine > gill > scale > muscle. Two age groups of *G. giuris* were also examined to find out the variation of heavy metal concentrations within age group (3-to-4 and 7-to-8 months' old); except for Hg, the contamination level was higher in the tissues of the younger age group compared to the older group.

Md. Kawser Ahmed, Sharif Ahamed, Safiur Rahman, Md. Rezaul Haque, Md. Monirul Islam (Bangladesh) Heavy Metals Concentration in Water, Sediments and their Bioaccumulations in Some Freshwater Fishes and Mussel in Dhaleshwari River, Bangladesh (pp 33-41)

ABSTRACT

Original Research Paper: The spatial and temporal distribution of heavy metals in water, sediment, fish and mussel of Dhaleshwari River, Bangladesh were determined by atomic absorption spectrophotometer. In water the concentrations of Ni, Pb, Cd, Cr and Cu varied seasonally and spatially from 5.47-9.74, 38.25-63.28, 5.29-8.20, 378.87-501.11 and 98.37-188.08 µg/L, respectively. The sediment also showed spatial and temporal variation of Ni, Pb, Cd, Cr and Cu ranges from 135.02-231.44, 58.19-70.26, 2.11-4.14, 95.76-141.27 and 31.53-76.52 mg/kg, respectively. These variations are likely to be due to different collection spots with point and non-point sources and seasons. The concentrations of Cd, Cr and Cu were higher, while Ni and

Pb were lower in water than those of sediment. In *Trypauchen vagina*, a bottom living fish, the concentration of Ni, Pb, Cd, Cr and Cu varied seasonally from 6.35-9.56, 6.14-8.03, 0.51-0.73, 6.92-12.23 and 5.43-9.45 mg/kg, respectively. The concentrations of heavy metals in this fish were much lower than those of water and sediment. In *Glossogobius giuris*, also a bottom living fish, the concentration of Ni, Pb, Cd, Cr and Cu varied seasonally from 4.75-10.17, 4.25-8.17, 0.61-0.71, 7.15-11.92, and 5.17-7.48 mg/kg, respectively, which were slightly lower (except Cd) than those of *T. vagina*. In *Lamellidens marginalis*, a fresh water bivalve, the concentration of Ni, Pb, Cd, Cr and Cu varied seasonally from 6.07-11.32, 7.03-59.21, 0.56-7.23, 9.38-501.11 and 7.55-183.87 mg/kg, respectively. The concentrations of all the heavy metals studied were much higher in mussel than those of fish that indicate the greater rate of bioaccumulation in mollusc.

Mosammat Salma Akter, Md. Kawser Ahmed, Anwarul Azim Akhand, Nazmul Ahsan, Md. Monirul Islam, Md. Shahneawz Khan (Bangladesh) Arsenic and Mercury Induce Death of *Anabas testudineus* (Bloch) Involving Fragmentation of Chromosomal DNA (pp 42-47)

ABSTRACT

Original Research Paper: Heavy metals are considered as devastating environmental pollutants that cause serious pollution of water bodies affecting aquatic inhabitants, including fishes. The objective of this work was to examine the toxicological effects of two major heavy metal pollutants, sodium arsenite (NaAsO_2) and mercuric chloride (HgCl_2), on fresh water climbing perch, *Anabas testudineus* (Bloch). HgCl_2 was found to be more toxic than NaAsO_2 and when fishes were exposed to different concentrations of these two metals, they required less time to induce fish death as their concentration increased. The highest concentration (1 mM) tested in this study induced fish death as early as 2 hours in HgCl_2 and 8 hours in NaAsO_2 treatments. Both heavy metals decreased total protein content of the exposed fishes in a concentration-dependant manner; however, no significant change was observed in fat, moisture and ash content. Liver cell viability was reduced to about 32 and 48% by HgCl_2 and NaAsO_2 , respectively. The death of the liver cells was accompanied by chromosomal DNA fragmentation. We later investigated whether the heavy metals could induce any change in protein expression and found that both heavy metals induced higher expression of a relatively high molecular weight protein detected on the upper portion of the gel. We conclude that mercury and arsenic showed their toxic effect by causing death of the fishes or fish cells involving fragmentation of chromosomal DNA and expression of certain high molecular weight proteins.

Number 2

Goni A. Dimari, Stephen S. Hati, Babagana Kolo (Nigeria) Pollution Monitoring in Urban Semi-Arid Environment Using Throughfall Variability in Chemical Composition and Total Particulate Matter (pp 48-52)

ABSTRACT

Original Research Paper: Three major aspects of pollution monitoring from throughfall collected under different trees formed the specific objectives of this study: (1) monitoring total particulate matter (TPM) trapped by the vegetation of this environment at a period when the influence of Harmattan is isolated, (2) assessing trees of this environment proficient in trapping particulate matter (PM) and (3) the chemical composition and alterations of throughfall against precipitation caught under the open field. *Acacia nilotica*, *Eucalyptus* sp., *Mangifera*, *Azadirachta indica*, *Tamarindus indica* and *Terminalia catappa* are common trees found in Maiduguri, Nigeria and were used for this study. Results showed a record high values of TPM (2.54 gm^{-2}), Cl^- ($36.40 \pm 4.72 \text{ mgL}^{-1}$), NO_3^- ($1.11 \pm 0.23 \text{ mgL}^{-1}$) and SO_4^{2-} ($5.45 \pm 0.82 \text{ mgL}^{-1}$) in throughfall. The general order of metal concentration found in throughfall was: Pb ($1.422 \pm 0.62 \text{ mgL}^{-1}$) > Cr ($0.547 \pm 0.16 \text{ mgL}^{-1}$) > Cd ($0.216 \pm 0.05 \text{ mgL}^{-1}$) > As ($0.102 \pm 0.06 \text{ mgL}^{-1}$). There were mostly statistically significant ($p < 0.05$) variations of these values amongst the different trees. *Mangifera* and *Azadirachta indica* were more proficient in intercepting and trapping PM amongst the six tree species studied in this work. The alterations of chemical compositions of throughfall against precipitation caught in the open field were observed to be significant in certain trees with an influence of dilution effects due to a higher amount of rainfall.

Wafaa M. Abd El-Rahim, Fatma H. Abd El-Zaher, M. Fayez, H. K. Abd El-Maksoud (Egypt) Utilization of Garlic (*Allium sativum* L.), Jasmine (*Jasminum officinale* L.), Thyme (*Thymus basilicum*) and Wheat Bran (*Triticum aestivum* L.) Wastes for Fungal Growth and Removal of Textile Dyes (pp 53-59)

ABSTRACT

Original Research Paper: There are great environmental concerns to develop new and efficient ways to remove azo-dyes

from wastewater. Among these ways abiotic and biotic agents were tested for removal of dyes. Cultivate of *Aspergillus niger* growth and the bioremoval of four textile dyes using several medicinal plants wastes has been studied. Three wastes of distillation medicinal aromatic plants namely; garlic (*Allium sativum* L.), jasmine (*Jasminum officinale* L.) and thyme (*Thymus basilicum*) in addition to wheat bran (*Triticum aestivum* L.) were used as growth media for *A. niger*. This fungus is used for textile dye bioremoval. The plant waste supported good growth of fungi in rather short incubation time (7 days). The aim of this study is to adopt low-cost technology for removal of some textile dyes by biotic or abiotic agents. Four commercial dyestuffs; direct violet, direct green, reactive red and acid red were included in this study. It was found that color bioremoval of the various dyes within 72 h of incubation using *A. niger* biomass varied from 40.2 to 99.6% of the original dye color. This finding was dye-dependent. In absence of fungi, the tested abiotic sorbents (wheat bran, jasmine, garlic and thyme) showed comparatively low removal capacity amounting < 60% in the majority of treatments. The bioremoval efficiency by fungi obviously rose up to > 90%. These findings confirm the role of fungi in decolorization of textile dyes.

Nagwa Elnwshy, Dalia Sabri (Egypt) Induction of HSP70 by Diazinon in *Oreochromis niloticus* (pp 60-61)

ABSTRACT

Research Note: This research investigated the possibility of using heat shock protein HSP70 in fish as a biomarker to evidence chronic exposure to pollution. Equally sized male tilapia *Oreochromis niloticus* were exposed to two separate concentration of diazinon for 30 days; 0.28 mg/L (Group 1 – G1) and 1.87 mg/L (Group 2 – G2). Both groups were recovered for 7 days (Group 3 – G3 and Group 4 – G4, respectively). The four groups were compared to control fish (Group 5 – G5) of equal size. Analysis of blood samples to test HSP70 induction was done using SDS/PAGE and molecular marker ranges between 214 and 6.8kDa. HSP70 proteins (71 and 77 kDa) were induced in G1 but the induction was removed by the recovery period in G3. While 78.16 kDa was induced in G2, the induction intensity decreased in G4. These results suggest that expression of HSP70 in tilapia is sensitive to chronic exposure to diazinon contamination in aquatic ecosystems, which reflects the cellular response of fish to the stress of water pollution.

B. Leena Grace, S. Viveka (India) Effect of Coconut Husk Retting on Three Backwater Regions along the Southwest Coast of India (pp 62-64)

ABSTRACT

Research Note: Hydrogen sulphide (H₂S) is a respiratory poison that suffocates organisms at high concentrations. Fishing and coir-making are two important sources of livelihood for the inhabitants of the coastal areas of the southernmost state of India, Kerala. The continued and intensive exploitation of the backwaters for retting of coconut husk has a deleterious effect on the inland fishery resources of the state. Pectinolytic activity of certain groups of bacteria causes offensive odors generating H₂S, which emanate from the retting zone besides causing turbidity and oxygen depletion. Thus, there is a clash between the coir and fishing industries in the state. The present study focused on three backwaters, Kadinamkulam, Veli and Poonthura, located around the state capital, Trivandrum in Kerala, which have been productive locations for fisheries in the past. Three stations (riverside, middle and bar mouth) were selected in each backwater area. Samples were collected from the surface and the bottom of these backwaters in the morning hours every month over a period of 12 months (April 2007 to March 2008), beginning before the monsoons of one year (June–September) and ending before the monsoons of the following year. H₂S and dissolved oxygen levels were analyzed quickly after sample collection and their monthly and seasonal variations are presented in this paper. In the present study, high concentrations of H₂S observed exceeded the tolerance limit (0.2 mg/L) fixed by the Indian Statistical Institute (ISI). This reflects the dangerous situation existing in the estuaries as sulphides are highly toxic and capable of destroying all organisms except for anaerobic bacteria in ecosystems.

B. Leena Grace (India) Nutrients and Dissolved Gases of Three Backwaters in the South West Coast of India (pp 65-67)

ABSTRACT

Research Note: Irrespective of man's influence, the concentration of nutrients are characteristically higher in river waters than in the surface sea waters and this leads to the general enhancement of nutrients in estuaries and in coastal waters due to land drainage. Knowledge of nutrients and dissolved gasses relating to their contributory sources, utilization levels and their availability will be of great value to assess the productivity potential of an estuary. With a view to understand the level of dissolved gases and nutrients in such estuaries, the present study envisages the nutrients and dissolved gasses in the three backwaters viz. Kadinamkulam, Veli and Poonthura. These three estuaries lie in the Trivandrum city of Kerala in the south west

coast of India. Collection of water samples for a period of one year (April 2007-March 2008) was made in a monthly interval. Collected samples from three different stations from each backwater were analyzed using standard methods for nutrients and dissolved gases. The results of the water quality parameters such as dissolved oxygen, hydrogen sulphide, ammonia–nitrogen, nitrite–nitrogen, phosphate–phosphorus and silicate–silicon were interpreted.

Yaqub Ahmed Geidam, Hamidu Usman, Hassan Ismail Musa, Franca Anosike, Yemisi Adeyemi (Nigeria) Oxytetracycline and Procaine Penicillin Residues in Tissues of Slaughtered Cattle in Maiduguri, Borno State, Nigeria (pp 68-70)

ABSTRACT

Research Note: A study was conducted in Maiduguri to detect the presence of antibiotics (oxytetracycline and procaine penicillin) residues in some tissues of cattle slaughtered for human consumption. Thin layer chromatography was utilized to qualitatively screen tissue samples by running in parallel with reference standards of both antibiotics. Out of the total 285 tissues sampled, muscle produced the highest incidence rate (32.6%) of oxytetracycline residue followed by liver (5.0%) and then kidney (3.1%). Similarly, muscle tissue produced the highest incidence rate (15.7%) of procaine penicillin residues followed by liver (13.0%) and then kidney (8.3%). The presence of residues of these commonly used antibiotics in tissues is a pointer to a serious public health risk as these antibiotics are also used in humans and may result in the development of bacterial strains resistant to these antibiotics. This underscores the need for a national residue monitoring program in Nigeria in accordance with international regulations.

Bhuban Mohan Panda, V. Balakrishna, Rabindra Nath Padhy (India) Estimating the Toxicity and Lethal Dose Concentration of Five Saline Salts and Two Pesticides to Cyanobacterium *Anabaena 7120* (pp 71-75)

ABSTRACT

Research Note: Cyanobacteria are considered as a helper microorganism in soil binding and soil formation in addition to incorporating nitrogen to the soil. They are adapted to a wide range of habitats. Most cyanobacteria fix atmospheric nitrogen and supply to the plants. For this reason, the cyanobacteria are considered as one of the important groups of beneficial microbes. The present study aimed to study the influence of five saline salts and two insecticides on filamentous heterocystous spore forming, nitrogen-fixing cyanobacterium, *Anabaena 7120*. Except for NaCl and MgCl₂, other salts at lower concentrations (Na₂CO₃ at 40 mg, Na₂SO₄ at 100 mg and MgSO₄ at 50 mg) stimulated growth of *Anabaena 7120* as assessed by optical density and an increase in cell number. Higher concentrations of all salts retarded growth. Both pesticides at low concentrations (10 mg/l) enhanced the growth of the cyanobacterium.