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CHEMICAL EFFECTS

Mechanisms and Assessment of Genotoxicity of Metallic Engineered Nanomaterials in the Human Environment

2024-10-20

Engineered nanomaterials (ENMs) have a broad array of applications in agriculture, engineering, manufacturing, and medicine. Decades of toxicology research have demonstrated that ENMs can cause genotoxic effects on bacteria, mammalian cells, and animals. Some metallic ENMs (MENMs), e.g., metal or metal oxide nanoparticles TiO2 and CuO, induce genotoxicity via direct DNA damage and/or reactive oxygen species-mediated indirect DNA damage. There are various physical features of MENMs that may play an important role in promoting their genotoxicity, for example, size and chemical composition. For a valid genotoxicity assessment of MENMs, general considerations should be given to various factors, including, but not limited to, NM characterization, sample preparation, dosing selection, NM cellular uptake, and metabolic activation. The recommended in vitro genotoxicity assays of MENMs include hprt gene mutation assay, chromosomal aberration assay, and micronucleus assay. However, there are still knowledge gaps in understanding the mechanisms underlying the genotoxicity of MENMs. There are also a variety of challenges in the utilization and interpretation of the genotoxicity assessment assays of MENMs. In this review article, we provide mechanistic insights into the genotoxicity of MENMs in the human environment. We review advances in applying new endpoints, biomarkers, and methods to the genotoxicity assessments of MENMs. The guidance of the United States, the United Kingdom, and the European Union on the genotoxicity assessments of MENMs is also discussed.

Authors: Benjamin M Liu, A Wallace Hayes

Full Source: Biomedicines 2024 Oct 20;12(10):2401. doi: 10.3390/biomedicines12102401.

Engineered nanomaterials (ENMs) have a broad array of applications in agriculture, engineering, manufacturing, and medicine.

Chemical Upcycling of Expired Pharmaceuticals as a Source of Value-Added Chemicals for Organic Synthesis and Medicinal Chemistry

2024-10-11

Pharmaceutical and veterinary products are a class of contaminants of emerging concern, and their presence in the environment is due to continuous and incorrect disposal. Environmental scientists have been accumulating data on their adverse effects on animal populations since

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toxicological effects on wildlife were first published. Therefore, recycling strategies are needed. Valuable active ingredients can be extracted from expired pharmaceuticals and recycled according to various strategies. In an effort to reveal the potential of the chemical upcycling of expired pharmaceuticals, the active ingredients gabapentin and pregabalin were extracted and used as starting materials to prepare a small collection of promising substrates endowed with functionalities and structural three-dimensionality. Gabapentin 1 was transformed into aminoalcohol 3, spiroamine 4, and the bioactive azaspirolactam 5. The lactam analog 6 was synthesized from pregabalin 2. Due to the biological profile of 5 and the structural similarity of the N-alkylated derivatives 5l and 6b with the drug piracetam, a collection of potentially bioactive structural analogs 5a-l and 6a-b were also prepared. Simple extraction, synthesis, and purification procedures were used as a means of chemical and economic revaluation, resulting in moderate to good yields at a low cost.

Authors: Teresa Abad-Grillo, Grant McNaughton-Smith

ENVIRONMENTAL RESEARCH

Combined environmental relevant exposure to perfluorooctanoic acid and zinc sulfate enhances apoptosis through binding with endogenous antioxidants in Daphnia magna

2024-10-24

Perfluorooctanoic acid (PFOA) is a long-chain legacy congener of the per- and polyfluoroalkyl substances (PFAS) family, notorious as a "forever chemical" owing to its environmental persistence and toxic nature. Essential elements such as zinc (Zn) can cause toxic effects when they change their metal speciation and become bioavailable, such as zinc sulfate (ZnSO4). Combined toxicity assessment is a realistic approach and a challenging task to evaluate chemical interactions and associated risks. Therefore, the present study aims to elucidate the acute mixture toxicity (12-48 h) of PFOA and ZnSO4 in Daphnia magna at environment-relevant concentrations (ERCs, low dose: PFOA 10 μg/L ZnSO4 20 μg/L; high dose: PFOA 20 μg/L ZnSO4 50 μg/L) in terms of developmental impact, apoptosis induction, and interaction with major endogenous antioxidants. Our results showed that deformity rates significantly increased ($p < 0.05$) with increasing exposure duration and exposure concentrations, compared to the control group. Further, lack of antenna, tale degeneration, and carapace alterations were the most commonly

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observed deformities following combined exposure to PFOA and ZnSO4, and these malformations were particularly pronounced after 48 h of exposure. Acridine orange (AO) staining was employed to examine apoptosis in D. magna, and apoptotic cells in terms of bright green fluorescence were detected in the abdominal claw carapace, heart, and post-abdominal area following exposure to a high dose of PFOA and ZnSO4. The molecular docking results revealed that both PFOA and ZnSO4 showed strong binding affinities with endogenous antioxidants CAT and GST, where PFOA was more strongly bound with CAT and GST with higher docking scores of -9.59 kcal/mol and -7.49 kcal/mol than those with ZnSO4 (-6.70 kcal/mol and -6.55 kcal/mol, respectively). In conclusion, the mixture exposure to PFOA and ZnSO4 at the environmental level induce developmental impacts and apoptosis through binding with major endogenous antioxidants in D. magna.

Authors: Naima Hamid, Muhammad Junaid, Nurhayati Binti Salim, Rakia Manzoor, Ong Meng Chuan

Full Source: Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association 2024 Oct 24:194:115074. doi: 10.1016/j.fct.2024.115074.

Potential health risks of inhaling hazardous chemical exposures at fuel stations: a pilot study in a hot, arid environment

2024-10-25

In recent years, there has been a growing focus on the issue of exposure to hazardous chemical compounds and the potential health risks associated with them. Fuel stations play a critical role in society, supporting the transportation industry and serving the general public. However, the routine activities at these stations expose workers and customers to dangerous chemical compounds, posing potential health risks. As part of a pilot study, the exposure of workers and customers to hazardous chemical compounds at fuel stations in Kuwait, characterized by its hot and arid environment, was investigated. The study specifically looked at volatile organic compounds (VOC) concentration and their effects on human health. Three hundred-eight air samples were collected in a hot, arid environment, focusing on fuel stations. Two sampling methods were used in this pilot study: personal inhalation exposure using active sampling and workplace air sampling using passive sampling. Samples were collected in fuel filling areas, indoor control rooms, and through personal exposures, adhering to ISO procedures (EPA TO-17). The study also assessed the non-carcinogenic and carcinogenic risks to human health to potential

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exposure to hazardous hazardous chemicals. The findings revealed that hazardous chemicals levels in the pump area were lower than those in the indoor control rooms. Workers' inhalation exposure to hazardous chemicals remained below the international occupational exposure limit (OEL). However, the study identified unsafe inhalation exposure levels to Benzene, which could have adverse carcinogenic effects. In contrast, exposure to ethylbenzene was found to be within safe limits, with no associated carcinogenic effects. This study underscores the importance of identifying the risks associated with exposure to hazardous chemical compounds to minimize human health risks and promote a safe working environment.

Authors: Mohamed F Yassin, Omar A Al-Qabandi, Nawaf S Alhajeri

Full Source: Journal of environmental science and health. Part A, Toxic/hazardous substances & environmental engineering 2024 Oct 25:1-11. doi: 10.1080/10934529.2024.2416328.

A critical review of microplastics in the shrimp farming environment: Incidence, characteristics, effects, and a first mass balance model

2024-10-28

This review provides a critical overview of the sources, incidence, accumulation, effects, and interactions of microplastics (MPs) with other contaminants in the shrimp aquaculture environment, emphasizing this sector's challenges and future implications. A first and novel mass MPs balance model was developed to explore the fate and fluxes of MPs within shrimp farming systems. Two literature searches were conducted: one focused on MPs, crustaceans, and shrimp in aquaculture, and other on the effects of MPs in crustaceans, emphasizing shrimp. A total of 78 and 461 peer-reviewed papers were retrieved, respectively. This review details aspects of MPs in the shrimp farming environment, including water, sediments, food, zooplankton, and shrimp tissues. MPs can act as vectors for contaminants, including biological and chemical substances commonly used in shrimp aquaculture. A primary concern is the interaction between MPs and pathogens; thus MPs can facilitate the transport and retention of disease-causing agents. Key questions involve identifying which pathogen groups are most efficiently transported by MPs and how this may exacerbate disease outbreaks in aquaculture. This suggests that microorganisms can establish on MPs surfaces to disseminate an infection. Therefore, the possibility of disease outbreaks and epidemics is expected to rise as MP abundance increases. The mass balance shows that the primary source of MPs is associated with water during the

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filled (19.3 %) and water exchange (77.2 %) of shrimp ponds, indicating that MPs in the water input play a critical role in the MP dynamic in the shrimp farming environment. However, this initial mass balance model has several weaknesses, including liming, atmospheric deposition, and natural food, which must be addressed as other MPs suppliers. Macrofauna that incidentally enters shrimp ponds may also constitute a significant part of the MPs inventory. Future research should focus on the impact of polystyrene and polyethylene fibers commonly found in crustacean tissues.

Authors: Federico Páez-Osuna, Gladys Valencia-Castañeda, Daniela Bernot-Simon, Uriel Arreguin-Rebolledo

Full Source: The Science of the total environment 2024 Oct 28:955:176976. doi: 10.1016/j.scitotenv.2024.176976.

PHARMACEUTICAL/TOXICOLOGY

Novel magnetic adsorbents based on oyster and clam shells for the removal of cadmium in soil

2024-10-24

Magnetic adsorbents can effectively remove heavy metals from soil. However, the magnetization process may reduce availability of adsorption sites, making it challenging to balance magnetic and adsorption properties. In this study, oyster shell (OS) and clam shell (CS) material was magnetized by an improved chemical co-precipitation method. The organic matter in the shells was destroyed by calcination modification to expose new active sites, and calcinated ferro-magnetic adsorbent was produced with either ferrosodium EDTA (giving CEOS and CECS) or with iron citrate (for CCOS and CCCS). All four modified adsorbents reached adsorption equilibrium for Cd2+ in solution within 120 min, with maximum adsorption capacities ranging from 115.5 to 266.5 mg/g, giving high removal efficiencies for Cd2+. Adsorption by precipitation and cation exchange mechanisms was dominant, together contributing >60 % of all adsorption capacity, followed by complexation. When used for remediation of Cd-contaminated soil, CEOS demonstrated the best Cd removal efficiency, achieving removal rates of 46 % and 58 % for total and available Cd, respectively. This was mainly because CEOS had the highest magnetic recovery rate, of 98 %. CEOS maintained removal rates of 34 % for total Cd after regeneration and reuse three cycles, with recovery rates remaining above 90 %. Contaminated soil was treated with the novel adsorbents and in pot experiments with water spinach cultivation it was shown that both CEOS and CECS treatment significantly reduced

Magnetic adsorbents can effectively remove heavy metals from soil.

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Cd content (by up to 56 %). The magnetic adsorbents presented here demonstrate excellent performance to remove Cd from water and soil, and have promising application prospects.

Authors: Heng Wang, Yuanqi Fu, Kexin Guo, Xiaofei Li, Xiaohu Jin, Yajing Huang, Xiaoyao Wang, Guining Lu, Xiaoyun Yi, Zhi Dang

Full Source: The Science of the total environment 2024 Oct 24:177083. doi: 10.1016/j.scitotenv.2024.177083.

Interaction Between Heavy Metals Posed Chemical Stress and Essential Oil Production of Medicinal Plants

2024-10-20

Plants exposed to abiotic stressors show diverse physiological, biochemical, and molecular responses. Biosynthesis of plant secondary metabolites-including essential oils-is a vital plant defense mechanism. As these bioactive compounds are widely used in the pharmaceutical, cosmetic and food industries, it is essential to understand how their production is affected in various environments. While interaction between specific abiotic stressors such as salt stress has been widely studied, relatively less information is available on how essential oil production is affected by toxic contaminants. Present review intends to give an insight into the possible interaction between chemical stress and essential oil production, with special regard to soil and air pollution. Available studies clearly demonstrate that heavy metal induced stress does affect quantity and quality of EOs produced, however, pattern seems ambiguous as nature of effect depends on the plant taxon and on the EO. Considering mechanisms, genetic studies clearly prove that exposure to heavy metals influences the expression of genes being responsible for EO synthesis.

Authors: Katalin Hubai, Nora Kováts

Full Source: Plants (Basel, Switzerland) 2024 Oct 20;13(20):2938. doi: 10.3390/plants13202938.

Plants exposed to abiotic stressors show diverse physiological, biochemical, and molecular responses.

OCCUPATIONAL

A Million Person Study Innovation: Evaluating Cognitive Impairment and other Morbidity Outcomes from Chronic Radiation Exposure Through Linkages with the Centers for Medicaid and Medicare Services Assessment and Claims Data

2024-10-28

The study of One Million U.S. Radiation Workers and Veterans, the Million Person Study (MPS), examines the health consequences, both cancer and non-cancer, of exposure to ionizing radiation received gradually over time. Recently the MPS has focused on mortality patterns from neurological and behavioral conditions, e.g., Parkinson's disease, Alzheimer's disease, dementia, and motor neuron disease such as amyotrophic lateral sclerosis. A fuller picture of radiation-related late effects comes from studying both mortality and the occurrence (incidence) of conditions not leading to death. Accordingly, the MPS is identifying neurocognitive diagnoses from fee-for-service insurance claims from the Centers for Medicare and Medicaid Services (CMS), among Medicare beneficiaries beginning in 1999 (the earliest date claims data are available). Linkages to date have identified 540,000 workers with available health information. Such linkages provide individual information on important co-factor and confounding variables such as smoking, alcohol consumption, blood pressure, obesity, diabetes and many other health and demographic characteristics. The total person-level set of time-dependent variables, outcomes, organ-specific dose measures, co-factors, and demographics will be massive and much too large to be evaluated with standard software. Thus, development of specialized open-source software designed for large datasets (Colossus) is nearly complete. The wealth of information available from CMS claims data, coupled with individual dose reconstructions, will thus greatly enhance the quality and precision of health evaluations for this new field of low-dose radiation and neurocognitive effects.

Authors: Lawrence T Dauer, Michael T Mumma, Julie C Lima, Sarah S Cohen, Daniel Andresen, Amir A Bahadori, Michael Bellamy, David Bierman, Steve Blattnig, Benjamin French, Eric Giunta, Kathryn Held, Nolan Hertel, Laura Keohane, Richard Leggett, Loren Lipworth, Kathleen B Miller,

The study of One Million U.S.

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Ryan Norman, Caleigh Samuels, Kali S Thomas, Sergei Tolmachev, Linda Walsh, John D Boice Jr

Full Source: Radiation research 2024 Oct 28. doi: 10.1667/RADE-23-00186.1.

Interaction of Cooking-Generated Aerosols on the Human Nervous System and the Impact of Caloric Restriction Post-Exposure

2024-10-17

Background: The inhalation of cooking-generated aerosols could lead to translocation to the brain and impact its function; therefore, the effects of cooking-generated aerosols on healthy adults were investigated using an electroencephalograph (EEG) during the 2 h period post-exposure. Methods: To explore any changes from the impact of exposure to cooking-generated aerosols on the human brain due to the absence of food intake during exposure, we divided the study participants into three groups: (A) no food intake for 2 h (2 h-zero calorie intake), (B) non-zero calorie intake, and (C) control group (simulated cooking). Results: The ultrafine particle concentrations increased from 9.0 × 103 particles/cm3 at the background level to approximately 8.74 × 104 particles/cm3 during cooking. EEGs were recorded before cooking (step 1), 60 min after cooking (step 2), 90 min after cooking (step 3), and 120 min after cooking (step 4). Comparing the non-zero calorie group with the control group, it was concluded that exposure to cooking-generated aerosols resulted in a 12.82% increase in the alpha band two hours post-exposure, compared to pre-exposure. The results revealed that zero calorie intake after exposure mitigated the impacts of cooking-generated aerosols for the alpha, beta3, theta, and delta bands, while it exacerbated effects on the whole brain for the beta1 and beta2 bands. Conclusions: While these are short-term studies, long-term exposure to cooking-generated ultrafine particles can be established through successive short-term exposures. These results underscore the need for further research into the health impacts of cooking-generated aerosols and the importance of implementing strategies to mitigate exposure.

Authors: Motahareh Naseri, Sahar Sadeghi, Milad Malekipirbazari, Sholpan Nurzhan, Raikhangul Gabdrashova, Zhibek Bekezhankyzy, Reza Khanbabaie, Byron Crape, Dhawal Shah, Mehdi Amouei Torkmahalleh

Full Source: Nutrients 2024 Oct 17;16(20):3525. doi: 10.3390/nu16203525.

Background:
The inhalation of cooking-generated aerosols could lead to translocation to the brain and impact its function; therefore, the effects of cooking-generated aerosols on healthy adults were investigated using an electroencephalograph (EEG) during the 2 h period post-exposure.

Hematological, cardiovascular and oxidative DNA damage markers associated with heavy metal exposure in electronic waste (e-waste) workers of Bangladesh

2024-10-24

Electronic waste (e-waste) contains hazardous elements such as lead (Pb), cadmium (Cd), mercury (Hg), and other toxic elements that pose significant health risks to the population directly exposed. We recruited 199 e-waste recycling workers and 104 non-exposed workers in Bangladesh and analyzed heavy metals in blood and hair, as well as hematological and cardiovascular parameters including, blood lipids and blood pressure. We fitted quantile regression models at 0.5 quantile to evaluate the impact of blood Pb, Cd, and total hair Hg (THg) on hematological and cardiovascular parameters and the role of oxidative DNA damage (8-OHdG as a biomarker) in mediating the relationship between exposures and outcomes. Exposed workers had elevated median blood Pb (11.89 vs. 3.63μg/dL), moderate blood Cd (1.04 vs. 0.99μg/L), and lower level of THg (0.38 vs. 0.57 ppm) in hair than non-exposed workers. Adjusted estimates showed that Pb was positively associated with red blood cell (RBC), eosinophil count, eosinophil percentage; and negatively associated with mean platelet volume (MPV), platelet large cell ratio (P-LCR) and platelet volume distribution width (PDW) (all $p \leq 0.05$). Cd was only associated with 0.57 units increase in red blood cell distribution width (RDW) percentage (95% CI: 0.18, 0.95). In cardiovascular outcomes, Pb was associated with 1.42 units decrease in triglyceride, 1.58 units increase in low-density lipoprotein (LDL), 0.07 units increase in LDL/HDL and 0.49 units increase in systolic blood pressure (all $p \leq 0.05$). No associations were observed between THg and hematological or cardiovascular parameters. Urinary 8-OHdG concentrations were lower, and it did not mediate exposure-outcome relationships (all $p \geq 0.05$). Our data imply that e-waste exposure impairs hematological parameters, blood lipids, and blood pressure secondary to elevated Pb levels and poses a threat to exposed individuals. As such, continuous monitoring in longitudinal studies is warranted to assess the dose-response relationship and identify effective control measures.

Authors: Sarker Masud Parvez, M Mamun Huda, Mahbubur Rahman, Farjana Jahan, Masatake Fujimura, Shaikh Sharif Hasan, Nirupam Aich, Abul Hares, Zahir Islam, Rubhana Raqib, Luke D Knibbs, Peter D Sly

Full Source: Toxicology 2024 Oct 24:153978. doi: 10.1016/j.tox.2024.153978.

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