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CHEMICAL EFFECTS

Impact of Repeated Organic Amendments on Trace Element Exposure and Health Risks via the Soil-Vegetable-Human Pathway

2025-03-06

Applying organic fertilizers enriches soil with essential nutrients and organic matter. However, the trace elements (TE) often present in organic fertilizers-such as chromium (Cr), cadmium (Cd), mercury (Hg) and arsenic (As)-can pose food safety risks. Continuous use of organic amendments can lead to the accumulation of TE in the soil, increasing their uptake by plants and potential risks to human health. To investigate this, we conducted a study across two production cycles to examine the presence of TE along the soil-plant-human contamination pathway. Our focus was on assessing the effects of repeated fertilizer applications on vegetable production and TE contamination, particularly in leafy (lettuce) and root (radish) vegetables. The results showed that using sewage sludge (SS), swine manure (SM), and chemical fertilizer (CF) led to higher vegetable yields compared to compost derived from municipal solid waste (CP). Soil amendments had limit impact on the overall TE concentrations in the soil. However, TE were more concentrated in vegetables grown with organic fertilizers than in those grown with chemical fertilizers. TE levels in the edible parts of vegetables increased significantly following repeated applications. In the first productive cycle of both vegetables, Zn and Cd exhibited moderate bioaccumulation, with BCF values ranging from 0.1 to 1.0. In the second cycle, bioaccumulation generally increased, with Zn reaching high bioaccumulation levels in lettuce under SS and SM treatments (BCF > 1.0). Cr in both vegetables and Cu in lettuce maintained moderate bioaccumulation levels. Conversely, both vegetables demonstrated strong defense mechanisms against Pb and As accumulation, as indicated by consistently low BCF values. According to the hazard quotient (HQ), repeated fertilization of lettuce with CF, CP, SS, and SM resulted in a 1.4-1.8-fold increase in the total hazard quotient (THQ) for adults and a 1.3-1.9-fold increase in radish bulbs, with a maximum THQ of 0.23 in the twice-CP fertilization treatment. Overall, the consumption of lettuce and radish grown in amended soils poses no significant health risk, as the THQ values remained consistently below 1.

Authors: Rui You, Anna Margenat, Núria Cañameras, Núria Carazo, Víctor Matamoros, Josep M Bayona, Sergi Díez

Full Source: Environmental research 2025 Mar 6:121326. doi: 10.1016/j.envres.2025.121326.

Photodegradation Controls of Potential Toxicity of Secondary Sunscreen-Derived Microplastics and Associated Leachates

2025-03-08

The escalating environmental concern over secondary microplastics (SMPs) stems from their physicochemical evolution from primary microplastics (PMPs), yet the contribution of varying physicochemical transformations to the ultimate environmental risks remains unknown. In this study, a photomechanical degradation process was employed to convert the primary sunscreen-derived microplastics (SDMPs) into secondary SDMPs. While mechanical degradation caused physical fragmentation, photodegradation induced both physical and chemical alterations, introducing surface oxidation, chemical bond scission, and cross-linking to the secondary SDMPs. Employing a combination of alkaline digestion and pyrolysis GC-MS techniques, it was observed that both physical fragmentation and photooxidation led to heightened intracellular sequestration of MPs. Although the bioaccumulated SDMPs could be indicated by the enlarged lysosomes and fragmented mitochondria, toxicity of secondary SDMPs at the cellular level was primarily driven by chemical transformations post-photodegradation. A nontargeted analysis employing high-resolution mass spectrometry identified 46 plastic-associated compounds in the leachate, with photodegradation-induced chemical transformations playing a crucial role in the dissociation of hydrophobic additives and oxidative conversion of leached compounds. The toxicity of the leachate was exacerbated by photodegradation, with mitochondrial fragmentation serving as the primary subcellular biomarker, indicative of leachate toxicity. This study elucidates the pivotal role of photodegradation in augmenting the cytotoxicity of secondary SDMPs, shedding light on the intricate interplay between physicochemical transformations and environmental risks.

Authors: Anqi Sun, Wen-Xiong Wang

Full Source: Environmental science & technology 2025 Mar 8. doi: 10.1021/acs.est.4c12077.

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Immobilization and release behaviors of uranium mediated by the redox processes between manganese oxides and dissolved organic matter: Effects of pH and goethite

2025-03-05

Both manganese dioxide (MnO_2) and dissolved organic matter (DOM) exert a significant influence on the chemical species of uranium in the contaminated soils, yet the impacts of the interactions between MnO2 and DOM, particularly in the presence of iron oxyhydroxides, on the environmental behaviors of uranium have not been elucidated. In this study, the dynamic behaviors of uranium were investigated during the reactions of DOM with δ-MnO2 in the presence of goethite at different pH values, by employing a combination of kinetic experiments, spectrophotometric titration, X-ray photoelectron spectroscopy, and electrochemical analysis. Our results indicated that the presence of DOM decreased uranium adsorption on MnO2 and promoted the release of uranium bound to DOM and MnO2 through the oxidation of DOM and the reduction of MnO2, respectively. Goethite increased uranium adsorption on its surface and hindered the direct oxidation of DOM by MnO2, but the indirect oxidation of goethite-adsorbed DOM by MnO2 provided an additional route for uranium release. We found that uranium concentration in solution was positively correlated with Mn(II) concentration at pH 4.5, whereas it was positively correlated with the concentration of dissolved organic carbon and negatively correlated with the aromaticity and molecular weight of DOM at pH 6.5. Above results highlighted the significance of the redox process between MnO2 and DOM in regulating the dynamic behaviors of uranium, which contributed to a better understanding of the sequestration and stability of uranium in the contaminated soils around the uranium tailings ponds.

Authors: Xixian Huang, Ye Dou, Bing Yang, Yang Ding

Full Source: Journal of hazardous materials 2025 Mar 5:490:137860. doi: 10.1016/j.jhazmat.2025.137860.

ENVIRONMENTAL RESEARCH

Association of infrastructure and operations with antibiotic resistance potential in the dairy environment in India

2025-03-04

The dairy industry in developing countries is often associated with inappropriate use of antibiotics and the subsequent contamination of the environment with co-selectors of antibiotic resistance. However,

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the specific factors in dairy farm environments that influence antibiotic resistance levels and the subsequent exposure risks to farm workers are unknown. We examined the link between the infrastructure and operations of the dairy farm and the antibiotic resistance potential in India, which is the highest producer and consumer of dairy products globally. We sampled sixteen dairy farms in the Dehradun district, India, that varied in their herd size, infrastructure, and operational features during winter, summer, and monsoon. We collected samples of dung, manure, wastewater, manure-amended, and control soil from these farms. We quantified six antibiotic resistance genes (ARGs) (sul1, sul2, parC, mcr5, ermF, and tetW), an integron integrase gene cassette (intI1), and 16S rRNA gene copies as an indicator for total bacterial count. We observed that the infrastructure and the operations of the dairy farms were significantly associated with antibiotic resistance potential in the dairy environment. For example, with increased ventilation and exposure to external weather, the levels of sul2 ($\tilde{x}$ =10-1.63) and parC ($\tilde{x}$ =10-4.24) in manure increased. When farmers administered antibiotics without veterinary consultation, the relative levels of intI1 ($\tilde{x}$ =10-2.36), sul2 ($\tilde{x}$ =10-1.58), and tetW ($\tilde{x}$ =10-3.04) in manure were lower than the cases where professional advice was sought. Small-scale farms had lower relative ARG levels than medium- and large-scale farms, except for mcr5 ($\tilde{x}$ =10-3.98) in wastewater. In different sample types, the relative ARG levels trended as manure-amended soil ($\tilde{x}$ =10-2.34) > wastewater ($\tilde{x}$ =10-2.90)> manure ($\tilde{x}$ =10-3.39)> dung ($\tilde{x}$ =10-2.54). ARGs correlated with the marker for horizontal gene transfer, intI1, which exacerbates overall antibiotic resistance levels. Exposure assessment showed that the agriculture farm workers working in manure-amended agriculture farms are exposed to higher antibiotic resistance potential than dairy farm workers, who manually handle dung. Our study showed that the link between the dairy infrastructure (ventilation and floor type) and operations (scale of operation and veterinary consultation) and the antibiotic resistance potential in the dairy farm environment was statistically significant. This knowledge paves the way for designing interventions that can minimize the antibiotic resistance potential on dairy farms and in affected environments and thus reduce the public health burden of antibiotic-resistant infections in the dairy industry and dairy workers in India.

Authors: Harshita Singh, Kenyum Bagra, Sourabh Dixit, Awanish Kumar Singh, Gargi Singh

Full Source: Preventive veterinary medicine 2025 Mar 4:239:106497. doi: 10.1016/j.prevetmed.2025.106497.

Associations of parental air pollution and greenness exposures with offspring asthma outcomes

2025-03-06

Background: Air pollution and greenness impact respiratory health, but intergenerational effects remain unclear.We investigated whether pre-conception parental residential exposure to air pollution and greenness at age 20-44 years is associated with offspring asthma outcomes in the Lifespan and inter-generational respiratory effects of exposures to greenness and air pollution (Life-GAP) project.

Methods: We analyzed data on 3684 RHINESSA study participants born after the year 1990 (mean age 19, standard deviation 4), offspring of 2689 RHINE study participants. Modelled annual concentrations of particulate matter (PM2.5, PM10), nitrogen dioxide (NO2), elemental carbon (EC), and ozone (O3), and greenness (Normalized Difference Vegetation Index, NDVI) were assigned to parental residential addresses in 1990, corresponding to 1-18 years prior to birth (mean: 6 years, SD: 5). We analyzed associations using generalized structural equation modelling (GSEM), with cluster-robust standard errors allowing for intra-family correlation, while adjusting for potential confounders.

Results: Among offspring participants, 18% reported lifetime asthma, 9% active asthma, 8% asthma medication, 5% asthma attacks, and 37% any asthma symptom. An interquartile range (IQR) increase in parental residential NDVI exposure was associated with less lifetime asthma (OR = 0.79, 95%CI: 0.64, 0.98 per 0.3 units). Similar associations were observed for active asthma and asthma medication use. Associations of air pollution with asthma outcomes were inconclusive.

Conclusion: Parental exposure to residential green spaces before conception was associated with lower asthma risk in offspring. Urban planning policies prioritizing green spaces may be a key public health intervention for future cities.

Authors: Robin M Sinsamala, Alessandro Marcon, Randi J Bertelsen, Simone Accordini, Jørgen Brandt, Lise M Frohn, Camilla Geels, Thorarinn Gislason, Mathias Holm, Christer Janson, Andrei Malinovschi, Iana Markevych, Hans Orru, Anna Oudin, Francisco Gomez Real, Torben Sigsgaard, Svein M Skulstad, Cecilie Svanes, Ane Johannessen

Full Source: Environmental research 2025 Mar 6:274:121328. doi: 10.1016/j.envres.2025.121328.

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PHARMACEUTICAL/TOXICOLOGY

Effects of Chemical Speciation on Chronic Thyroid Toxicity of Representative Perfluoroalkyl Acids

2025-03-07

Acute exposure studies have reported that chemical speciation significantly affects the developmental toxicity of perfluoroalkyl acids (PFAAs). However, the mechanisms underlying the chronic toxicity of PFAAs as a function of chemical speciation remain unknown. With an aim to gain more insights into the PFAA structure-toxicity relationship, this study exposed adult zebrafish to the acids and salts of perfluorooctanoate (PFOA), perfluorobutanoate (PFBA), and perfluorobutanesulfonate (PFBS) at environmentally realistic concentrations for 5 months. In the F0 generation, PFAA acids induced hypothyroidism symptoms more potently than their salt counterparts. After parental exposure, a chemical speciation-dependent transfer behavior was noted, with a greater burden of PFAA acids in the offspring. Similarly, PFAA acids were associated with higher risks of transgenerational defects and thyroid dysfunction during offspring embryogenesis. PFAA acids bound to thyroid receptor beta (TRβ) more strongly than their salts. An antagonistic interaction of PFOA and PFBS with TR activity was observed in vitro via the reduction of TRβ accessibility to target genes. CUT&Tag sequencing revealed disturbances due to PFAAs on the genomic target profile of TRβ, indicating that PFOA and PFBS interfere with multiple thyroidal and nervous processes. In conclusion, current findings provided evidence regarding the critical effects of chemical speciation on PFAA toxicity, highlighting the need to perform discriminative risk assessment and chemical management.

Authors: Jing Li, Qi Wang, Chenyan Hu, Baili Sun, Zixie Yang, Bingsheng Zhou, Kenneth Mei Yee Leung, Lianguo Chen

Full Source: Environmental science & technology 2025 Mar 7. doi: 10.1021/acs.est.4c10997.

Aflatoxin B1 exposure induces Alzheimer's disease like pathology by disrupting redox homeostasis and activating ferroptotic signals in C57BL/6 J mice

2025-03-06

Aflatoxin B1 (AFB1) is one of the most toxic mycotoxins with neurotoxicity. Human exposure to AFB1 via contaminated foodstuffs has been linked to the risk of cognitive impairment, which may contribute to the progression of Alzheimer's disease (AD). However, the mechanism underlying the

pathogenesis of AD in relation to AFB1 exposure is not clear. Herein, C57BL/6 J mice were exposed to 1.5 mg/L AFB1 in drinking water for 8 weeks. It was found that AFB1 damaged blood-brain barrier function, accumulated in the brain, and led to cognitive impairments and AD-like pathology in the hippocampus. Impaired cognitive function was indicated by the significant alterations in Morris' water maze and Y-maze tests at 8 weeks after AFB1 exposure. Concurrently, AD-like pathology was evinced by a marked neuronal loss and the up-regulated AD related gene and protein expressions in the hippocampus. AFB1 exposure remarkably disrupted redox homeostasis and induced ferroptosis both in the hippocampus at 8 weeks after AFB1 exposure and in cultured hippocampal neuron in vitro as indicated by the suppressions on SOD and CAT activities, the down-regulation of Slc7a11/Gpx4 expressions, the decline in GSH content, the increase in MDA and the lipid peroxidation. AFB1 exposure also increased Fe2+ content significantly at 8 weeks after exposure. In addition, we demonstrated that ferroptosis inhibition by Fer-1 obviously alleviated AFB1 neurotoxicity in HT22 cells. These results revealed an unknown pivotal role of ferroptosis in AFB1 neurotoxicity in relation to AD pathogenesis and emphasized the importance to reduce the health risk of AFB1 exposure as an etiology of AD in humans.

Authors: Jinxian Lin, Huihui Hong, Sicheng Liu, Zhengwei Liang, Qixue Zheng, Kun Luo, Jiayi Li, Zhulin Du, Jinping Yu, Lingling Yang, Ping Deng, Huifeng Pi, Zhengping Yu, Wei Yuan, Zhou Zhou

Full Source: The Science of the total environment 2025 Mar 6:970:179049.
doi: 10.1016/j.scitotenv.2025.179049.

Prenatal exposure to organochlorine pesticides and polychlorinated biphenyls and risk of testicular germ cell cancer later in life

2025-03-07

Introduction: Exposure to environmental chemicals during fetal development may increase the risk of testicular germ cell cancer (TGCC), but few studies have tested the hypothesis. We focused on organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs), previously investigated in relation to other male reproductive health outcomes.
Methods: We conducted a nested case-control study of 332 mother-son pairs, comprising 65 TGCC cases and 267 controls, identified from a Danish Pregnancy Screening Registry with biobanked serum samples collected from pregnant women in 1985-1995, when exposure to the studied chemicals was relatively high. We quantified seven OCPs and 13 PCB congeners in maternal serum by gas chromatography tandem mass spectrometry. TGCC diagnoses and covariate information were derived from the nationwide Danish registries. We estimated associations between individual chemicals and their mixture with the risk of TGCC through adapted Cox regression and quantile g-computation models.
Results: Median age at TGCC diagnosis was 24.7 years. In main analyses, associations between individual OCPs and PCBs and risk of TGCC showed either slightly higher risks or no association (close to Hazard Ratios (HR) of 1.00), with confidence intervals overlapping unity. In mixture analyses, simultaneously increasing all chemical concentrations by one quartile resulted in a slightly higher risk of TGCC (HR 1.11, 95 % CI: 0.61; 2.05) after adjusting for confounders. Sensitivity analyses investigating tertiles of concentrations did not change the overall pattern of results.
Conclusions: Prenatal exposure to OCPs and PCBs, quantified by concentrations in maternal pregnancy serum, was not associated with later risk of TGCC.

Authors: Cecilie S Uldbjerg, Panu Rantakokko, Youn-Hee Lim, Jørgen H Petersen, Karina M Sørensen, Brent A Coull, Christian Lindh, Russ Hauser, Elvira V Bräuner, Niels E Skakkebæk, Lærke Priskorn, Anders Juul

Full Source: The Science of the total environment 2025 Mar 7:970:179054.
doi: 10.1016/j.scitotenv.2025.179054.

OCCUPATIONAL

The association between occupational lead exposure and serum levels of vitamin D3 and a bone turnover biomarker in smelter workers

2025-03-08

Objective: Bone tissue is the chief target for lead (Pb) in chronic exposure. This study aimed to demonstrate the relation between the blood lead levels (BLL) and serum levels of 1,25 dihydroxy cholecalciferol (vitamin D3) and type I collagen cross-linked C-telopeptide (CTX-1) as a biomarker of bone turnover among some Egyptian workers occupationally exposed to Pb in the smelting process. The study also targeted to identify any clinical manifestations indicative of skeletal system affection and their association with the performed investigations.
Methods: A total of 48 smelter workers and 48 administrative controls participated in the study. All subjects underwent comprehensive medical and occupational history taking and detailed clinical examinations, with a particular focus on symptoms indicative of skeletal system involvement. These symptoms included generalized bony aches, low back pain, joint

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pain, restricted joint movement, a history of fractures from minor trauma, and delayed fracture healing. BLL, as well as serum levels of vitamin D3 and CTX-1, were measured in all participants.
Results: Smelter workers exhibited significantly higher prevalence of bony aches, low back pain, joint pain, and past fractures from minor trauma compared to controls. The BLL and serum CTX-1 levels were significantly elevated in the exposed group, while serum vitamin D3 levels were notably lower. Logistic regression analysis revealed that BLL significantly predicted bony aches and low back pain. Additionally, serum vitamin D3 and CTX-1 levels were significant predictors of low back pain and joint pain, respectively, among exposed workers. The measured parameters were significantly correlated with one another and with the duration of employment in the exposed group.
Conclusion: Significant associations between manifestations of skeletal system affection, BLL, and serum levels of vitamin D3 and CTX-1 were detected among smelter workers with chronic occupational exposure to Pb.
Authors: Rateba Said Mohammed, Basma Hussein Mourad
Full Source: International archives of occupational and environmental health 2025 Mar 8. doi: 10.1007/s00420-025-02125-y.

Chemical exposure in females of childbearing age associated with sex hormones: Evidence from an untargeted exposomic approach

2025-03-03
Exposure to organic chemicals can cause reproductive hormones disturbance in women. However, there is very limited evidence regarding real-world chemical exposures in reproductive-aged women and their joint effects on sex hormone levels. Here, we applied non-targeted screening workflow based on High-Performance Liquid Chromatography-High-Resolution Mass Spectrometry to investigate the serum chemical exposome of 156 women of childbearing age from Jinan, China. A total of 185 exogenous chemicals from 19 categories were identified in at least 80% of serum samples with confidence levels 1-3, 84 of which have never been reported in humans, and 9 of those showed active effects on multiple biological targets in ToxCast program. A combination of grouped weighted quantile sum regression (GWQS), weighted quantile sum regression (WQS), quantile g calculation (q g-comp), and Bayesian kernel machine regression (BKMR) models indicated significant associations of chemical mixture exposure with progesterone (P4), testosterone (T), and luteinizing hormone (LH)/follicle-stimulating hormone (FSH) ratios, and 7,

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4, and 8 priority contributors were identified, respectively, such as fipronil sulfone for P4, dicyclohexyl phthalate for T, and 3-hydroxybenzyl alcohol for LH/FSH. Three chemicals closely related to androgen synthesis and metabolism were proposed. Restricted cubic spline curves showed that 10 of the 28 priority compound-hormone pairs displayed significant non-monotonic exposure-response relationships. This study provides more information on the chemical exposome in Chinese women of childbearing age and has important implications for understanding the effect of chemical co-exposure on sex hormone homeostasis in women.
Authors: Minmin Hou, Song Tang, Feng Zhang, Shanji Fu, Hao Ding, Yu'e Cha, Xiao Ma, Yali Shi, Yaqi Cai
Full Source: Environment international 2025 Mar 3:197:109362. doi: 10.1016/j.envint.2025.109362.