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CHEMICAL EFFECTS

Assessing the phytotoxicity of emerging pollutants on vegetable crops grown with sewage effluent

2025-06-12

The use of sewage effluent in agriculture introduces a variety of emerging contaminants-including nanomaterials, surfactants, cosmetic products, endocrine-disrupting chemicals (EDCs), flame retardants (FRs), antibiotic resistance genes (ARGs), personal care products (PCCPs), antibiotics, pesticides, and micro(nano)plastics (MNPs)-into agroecosystems, posing significant risks to crop safety and human health. This review assesses the phytotoxicity of these pollutants on vegetable crops, emphasizing their detrimental effects on plant physiology, nutritional quality, and long-term soil health. We explore multifaceted mechanisms driving contaminant uptake and bioaccumulation, such as direct cellular translocation, endocytosis, rhizosphere interactions, molecular mimicry of transporters etc. To address these challenges, we have also proposed integrated remediation strategies and cross-cutting techniques, including bioaugmentation with tailored microbial consortia, advanced oxidation processes, phytoremediation CRISPR-engineered microbes for targeted degradation etc. By synthesizing physiological, molecular, and ecological insights, this work provides a roadmap for mitigating contamination risks, enhancing food safety, and promoting sustainable agricultural practices in sewage-impacted systems.

Authors: Ashish Tiwari, Nidhi Tiwari, Uttara Tiwari

Full Source: The Science of the total environment 2025 Jun 12:989:179865.
doi: 10.1016/j.scitotenv.2025.179865.

Effects of global treaties on commercial chemicals widely used as additives: a meta-analysis of historical measurements of polybrominated diphenyl ethers

2025-06

Background: Commercial organic additives, many of which possess persistent, bioaccumulative, and toxic (PBT) features, are widely used in various products. Although some PBT chemicals have been restricted, the risks associated with long-term exposure remain. Polybrominated diphenyl ethers (PBDEs) are flame retardants in electronics, textiles, and many everyday products. They are a typical class of ubiquitous additive chemicals with PBT characteristics. PBDEs include three commercial formulations: penta-BDE, octa-BDE, and deca-BDE. Penta-BDE and octa-

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BDE were banned in most countries in the early 2000s and listed under the Stockholm Convention in 2009 with recycling exemptions. Deca-BDE was banned later, with the USA starting to phase it out in 2009, and was added to the Convention in 2017 only with exemption for inclusion in vehicle parts until 2036. We conducted a meta-analysis and systematic regression analysis to explore the impact of global policies and treaties on both internal (human) and external (environmental) exposure to PBDEs.
Methods: On Jan 4, 2023, we conducted a search of electronic databases including Web of Science, Scopus, Embase, and PubMed, along with grey literature. The search results were updated on March 21, 2025. The inclusion criteria focused on studies reporting PBDE concentrations in indoor dust (a major source of external exposure) and in the human body (internal exposure). We collated concentration data of major PBDE congeners, which are present in different formulations of flame retardants used in different products, including BDE-47, BDE-99, BDE-153, BDE-183, and BDE-209. We used a breakpoint regression model to analyse the temporal trends of PBDEs and compared these trends with the timeline of national and regional policies.
Findings: We identified 9782 studies, of which 343 were included, covering data from 94 countries worldwide. Marked differences were observed in PBDE internal and external exposure across countries. Using the EU, China, and the USA as examples, we summarised the general temporal patterns of large-scale indoor emissions (which dominate exposures of the general population) of different PBDE congeners and their effects on human exposure, correlating with treaty, production, and usage schedules.
The results indicate that PBDE emissions in indoor environments have decreased following policy interventions, but reductions in human PBDE levels have been delayed and slow. Using breakpoint regression modelling, we identified a significant turning point in the concentrations of low-brominated PBDEs (BDE-47: 1996 [95% CI 1991-2001], p<0·0001; and BDE-99: 1997 [1992-2003], p<0·0001) in human milk in the EU. Significant decreases were observed in both China (BDE-47, p=0·0008; BDE-99, p=0·011) and the USA (BDE-47, p=0·0023; BDE-99, p=0·041). However, no decreasing trend over time was evident for BDE-153, nor for the higher-brominated BDE-183 (except in the EU: p=0·010) and BDE-209. In adult serum, PBDE concentrations showed minimal decreases, with only BDE-183 showing a significant decline in the EU (p=0·0099).
Interpretation: Long-term emissions from treated products with large stocks of these chemicals after bans, along with the bioaccumulation of PBDEs (especially BDE-153), have significantly delayed the effectiveness of treaties in eliminating human exposure and health risks. Moreover, regionally varied policy enforcement and consumption patterns

have further reduced effectiveness of these treaties on a global scale. The chemical diversity of different PBDE congeners also affects the effectiveness of the bans. Currently, there is a paucity of systematic longitudinal studies to evaluate the effectiveness of monitoring at both global and national levels. This study highlights the need for more cautious and stringent chemical regulations and a unified global monitoring and management framework in the future, to better regulate commercial additives.
Funding: National Natural Science Foundation of China (42377362) and Shanghai Oriental Talent Program-Youth Project.
Authors: Guangbin Zhong, Zengwei Li, Kevin C Jones, Ying Zhu
Full Source: The Lancet. Planetary health 2025 Jun;9(6):e538-e552. doi: 10.1016/S2542-5196(25)00114-7.

Approaches to managing ototoxicity in the workplace

2025-06-14
Objective: Ototoxic chemicals in the workplace can pose a risk to hearing and balance functions. Our objective was to identify evidence-based practices for occupational health settings in managing ototoxicity. This resulted in the document, Health Management of Workers Exposed to Ototoxic Chemicals, created by the International Ototoxicity Management Group.
Design: To develop a practical approach for any workplace, we reviewed a variety of sources and used an international panel of interdisciplinary experts. Evidence included data from experimental, observational, and review studies. Thirty-two subject matter experts were invited to review the document; twenty-two completed the review and unanimously endorsed the ototoxicity management system as proposed.
Results: Six key action steps were proposed to: (1) identify workers exposed to ototoxic chemicals, (2) perform auditory and vestibular assessments, (3) follow-up after monitoring health, (4) document worker data, (5) maintain healthy safety culture, and (6) review ototoxicity management approach. These steps focus on the management of workers who are at-risk for workplace ototoxic chemical exposure at any level (with or without concurrent noise exposures).
Conclusions: Early identification strategies include self-report questionnaires; auditory testing; vestibular screening; referrals for diagnosis; management of cases; and monitoring of exposure scenarios to prevent further cases.
Authors: Thais C Morata, Krystin Carlson, Adrian Fuente, Gayla L Poling, Angela Garinis, Timothy Hullar, John Lee, Benoit Pouyatos, Mariola

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Sliwinska-Kowalska, Laura Dreisbach, Hunter Stuehm, Dawn Konrad-Martin
Full Source: International journal of audiology 2025 Jun 14:1-10. doi: 10.1080/14992027.2025.2508728.

ENVIRONMENTAL RESEARCH

Environmental and occupational exposure to erionite and related health risks: progress and prospects

2025-06-13
Objectives: Erionite, a naturally occurring fibrous zeolite classified as a human carcinogen, is believed to be more potent than asbestos in causing mesothelioma. However, unlike asbestos, erionite has rarely been used for commercial purposes and, as a result, knowledge about exposure pathways is limited. This paper provides a narrative review of the current knowledge regarding the associations between erionite exposure, health effects and exposure circumstances.
Methods: Medline/PubMed and Scopus were systematically searched up to the end of 2024 using keywords related to erionite exposure and health outcomes.
Results: We identified 26 peer-reviewed journal articles reporting on the health effects of erionite exposure, specifically mesothelioma and lung cancer, with mesothelioma being the most extensively studied outcome. Of these, 12 studies focussed on erionite-exposed populations in Turkey, 8 examined health effects among Turkish migrants in northern Europe, and 6 investigated erionite-related health risks in North America (3 in the United States and 3 in Mexico). These studies showed a very high incidence of mesothelioma, often in relatively young individuals, from the Cappadocia region of Turkey, with well-documented environmental exposures to erionite, contributing to a high proportion of all deaths (21% to 51%) in affected villages. Evidence of lung cancer associated with erionite exposure was also found. There is also evidence of erionite exposure-associated mesothelioma in Guanajuato, central Mexico.
In the United States, erionite exposure-associated health effects (not mesothelioma) have been reported among people occupationally exposed to erionite. Studies on environmental exposures have shown outdoor concentrations ranging from 0.001 f/ml to 0.3 f/ml, while indoor concentrations have ranged from 0.005 to 1.38 f/ml. Occupational exposure to erionite has been less studied, with only one study in forestry workers showing elevated exposures to erionite ranging from non-detectable to 0.36 f/cc. Erionite deposits have also been identified in other

countries such as Italy and New Zealand, but exposures and associated health effects have not yet been studied in these regions.
Conclusion: There is clear evidence that environmental exposure to erionite in the Cappadocia region of Turkey, and Guanajuato in central Mexico are causally associated with the high mesothelioma rates observed in these areas. Evidence for other parts of the world where there is naturally occurring erionite is limited. This review has highlighted significant knowledge gaps, and advocates for further research on occupational exposure to erionite fibres and associated health effects.
Authors: Grace Chen, Andrea 't Mannetje, Jennifer A Salmond, Jeroen Douwes
Full Source: Annals of work exposures and health 2025 Jun 13:wxaf034. doi: 10.1093/annweh/wxaf034.

Maternal exposures to ambient carbon particulate pollution and the risk of gestational hypertension or pre-eclampsia: a retrospective cohort study in Beijing, China, 2014-2018

2025-06-15
Objectives: We aimed to investigate the impact of ambient carbon particles on hypertensive disorders in pregnancy (HDP) and evaluate whether the associations differed by maternal characteristics.
Methods: A retrospective cohort study was constructed based on data from the Haidian Maternal and Child Health Hospital in Beijing, China. A total of 41 374 participants with last menstrual period dates between 2014 and 2018 were included. Black carbon (BC), ultraviolet light absorbing particulate matter (UVPM), delta carbon (Delta-C) and brown carbon (BrC) were measured at a fixed air monitoring site. Source contributions to BC were analysed using the Aethalometer model. Delta-C has been used as a specific indicator for wood-smoke pollution, and both UVPM and BrC represent a typical cluster of organic fractions. Logistic regression models were used to estimate the association between carbon particle exposure and gestational hypertension or pre-eclampsia risk and identify sensitive windows.
Results: We observed that pre-eclampsia risk was associated with UVPM and Delta-C exposure during the first trimester, with ORs per IQR increase in exposure being 1.27 (95% CI 1.03 to 1.58), and 1.60 (95% CI 1.32 to 1.94), respectively. Pre-eclampsia risk was associated with BC, UVPM, Delta-C and BrC exposure 3 months before conception. No significant associations were found between carbon particles and gestational hypertension. Stronger associations were observed for BC from traffic sources. Subgroup analyses indicated greater risks among participants who were over 30 years old, weighed over 60 kg and were nulliparous.
Conclusions: Our findings suggest that carbon particle exposure may be associated with increased pre-eclampsia risk during early pregnancy, highlighting the importance of anthropogenic emission control for reducing adverse health impacts.
Authors: Mengyao Li, Yinzhu Zhao, Hongbing Xu, Xiaoxuan Zou, Xinghou He, Haiyan Liu, Bin Zhang, Hanbin Wu, Xuyang Shan, Shuo Wang, Jueming Lei, Haishan Yang, Chuanyu Zhao, Meina Hu, Xiaoming Song, Ying Yang, Wei Huang
Full Source: Occupational and environmental medicine 2025 Jun 15:oemed-2024-110028. doi: 10.1136/oemed-2024-110028.

PHARMACEUTICAL/TOXICOLOGY

Buccal micronucleus cytome assay to evaluate cyto-genotoxic effects of occupational exposure to antineoplastic drugs: application on a large sample size of workers furnished by an Italian network of oncological hospitals

2025-06-14
Many antineoplastic drugs (ADs) used to treat cancer are characterized by the non-selective effect representing a possible cause of health effects in exposed workers. We established an Italian Network of seven Oncological Hospitals with the aim to evaluate, on a large size sample of workers, cyto-genotoxic effects by a sensitive and non-invasive biomarker also detecting workplace and personal contamination. We performed Buccal Micronucleus Cytome (BMCyt) assay on 200 workers handling ADs and 150 controls. AD contamination was detected performing workplace and personal monitoring of Gemcitabine, Ifosfamide, Cyclofosfamide and 5-Fluorouracil, using UHPLC MS/MS. We found in all the exposed group higher mean values of cells with micronucleus (MN‰), higher percentage of positivity to MN (subjects with micronucleated cells frequency exceeding a fixed cut-off value (1.5‰)), higher frequency of binucleated cells, broken eggs and total anomalies than in the controls. Taking into account the tasks (preparation, administration in Day Hospital and wards, administration in room operator and disposal), only preparators and administrators showed higher MN‰ frequency than in controls, whereas each task group showed a similar higher percentage of MN positives than in controls. We found low levels, but still detectable, of contamination

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in all the monitored workplaces. This study demonstrated induction of genotoxicity and of cytokinesis defect/arrest in buccal cells of workers handling antineoplastic drugs. The BMCyt assay was demonstrated to be a suitable biomarker of effect for biomonitoring of workers handling AD due to its high sensitivity and non-invasivity.
Authors: C L Ursini, E Omodeo-Salè, G Di Gennaro, G Buresti, A M Fresegna, A Ciervo, M Gentile, R Maiello, S Beltramini, D Gaggero, N Rigamonti, E Maccari, G Zorzetto, P Maiolino, P Di Filippo, M C Bilancio, P Baldo, V Martinello, A Di Mattia, C Esposito, P Nardulli, M Laforgia, D Cavallo
Full Source: Archives of toxicology 2025 Jun 14. doi: 10.1007/s00204-025-04073-5.

A case-control study of early-life residential exposure to tetrachloroethylene and risks of childhood cancer and birth defects

2025-06-10
Background: Residential buildings with a co-located dry-cleaning facility (CL-DC) can have substantially higher indoor tetrachloroethylene concentrations than buildings without a CL-DC. We conducted a case-control study to investigate associations between early-life indoor tetrachloroethylene exposure from CL-DCs and risks of childhood cancers (overall, acute lymphoblastic leukemia) and birth defects.
Methods: We linked records between the New York City (NYC) Bureau of Vital Statistics and the New York State Cancer Registry and Birth Defects Registry to identify cases of childhood cancers (n = 5,334) and birth defects (n = 171,553) diagnosed among children born in NYC between 1988 and 2016, and controls without these conditions (n = 596,599). We identified CL-DC exposure by mapping addresses from birth certificates and DC permits involving tetrachloroethylene use to building footprints, and modeled tetrachloroethylene concentrations using measurement data from a survey of NYC CL-DCs. Using unconditional logistic regression, we computed odds ratios (ORs) and 95 % confidence intervals (CIs) relating study endpoints to CL-DC exposure.
Findings: Living in a building with a CL-DC at birth was associated with aortic valve stenosis (AVS; OR = 3.1, 95 % CI = 1.6, 5.9), with an exposure-response effect for predicted tetrachloroethylene concentration (≤44 μg/m3: OR = 2.7, 95 % CI = 1.0, 7.4; >44 μg/m3: OR = 3.9, 95 % CI = 1.6, 9.5) and stronger associations for children whose mother was non-White, less than college-educated, or lived at birth in majority non-White or poorer neighborhoods. We observed null findings for other endpoints.

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Conclusions: In this first-ever case-control study, early-life tetrachloroethylene exposure from CL-DCs in residential buildings was associated with increased AVS risk. These findings warrant further investigation.
Authors: Jongeun Rhee, Adrian M Michalski, Margaret Gates Kuliszewski, Jamie Musco, Catherine T Adler, Shuai Xie, Melissa C Friesen, Tabassum Insaf, Mark P Purdue
Full Source: Environment international 2025 Jun 10:201:109600. doi: 10.1016/j.envint.2025.109600.

Silver Nanoparticles (AgNPs) as a Double-Edged Sword: Synthesis, Factors Affecating, Mechanisms of Toxicity and Anticancer Potentials-An Updated Review till March 2025

2025-06-13
Silver nanoparticles (Ag-NPs) are widely utilized in cosmetics, healthcare, and antimicrobial products due to their potent antimicrobial and anticancer properties. However, their increasing use raises concerns about cytotoxic effects on human health and the environment. Ag-NPs interact with biological systems in a size-, dose-, and time-dependent manner, with particles smaller than 10 nm often exhibiting heightened toxicity. In vivo studies show their ability to cross the blood-brain barrier and accumulate in organs such as the liver, spleen, and brain. This review critically evaluates the cytotoxic mechanisms and anticancer therapeutic potential of Ag-NPs, presenting them as a double-edged sword. A comprehensive literature search was conducted on the PubMed, Scopus, Web of Science, etc. database for the period 2005-2025 using keywords including "Silver Nanoparticles AND anticancer," "tumor," and "cytotoxicity." The search yielded 1100 articles related to anticancer activity, 2879 on cytotoxicity, 460 on green-synthesized Ag-NPs tested for anticancer effects, and 3418 on green synthesis of AgNPs alone. The review discusses how physicochemical properties-such as size, shape, and surface chemistry-influence cytotoxicity through mechanisms like oxidative stress, mitochondrial damage, and DNA disruption. It also highlights recent advancements in Ag-NP synthesis and biomedical applications, underscoring the importance of balancing their therapeutic benefits against potential health risks.
Authors: Abhinav Sati, Suraj N Mali, Tanvi N Ranade, Susmita Yadav, Amit Pratap
Full Source: Biological trace element research 2025 Jun 13. doi: 10.1007/s12011-025-04688-w.

OCCUPATIONAL

Oxidative damage, genetic and epigenetic alterations in hexavalent chromium exposed workers - A cross-sectional study within the SafeChrom project

2025-06-12

Background: Hexavalent chromium (Cr(VI)) is a lung cancer carcinogen. However, the genotoxic and mutagenic effects of Cr(VI) in humans at low-to-moderate occupational exposure levels are unknown. This study aims to investigate the relationship between occupational exposure to Cr(VI) and the presence of oxidative damage, genetic and epigenetic alterations.
Methods: We included 113 Cr(VI) exposed workers in 14 companies and 72 controls recruited within the SafeChrom project. Cr(VI) was measured in inhalable dust and total chromium in urine (U-Cr) and red blood cells (RBC-Cr). Analysed effect biomarkers included urinary 8-hydroxy-2'-deoxyguanosine (8-OHdG), micronuclei in peripheral blood reticulocytes (MNRET), blood relative mitochondrial DNA copy number (mtDNA-cn), relative telomere length (TL), and blood DNA methylation of four lung cancer-related genes (F2RL3, LINE-1, MGMT promoter and SEMA4B).
Results: The median inhalable Cr(VI) concentration among the exposed workers was 0.11 µg/m3 (5th-95th percentile: 0.02-8.44). Exposed workers showed higher 8-OHdG, TL, and MGMT promoter methylation levels and lower mtDNA-cn and MNRET compared with controls. Company-based differences in biomarkers were observed. Univariate analysis showed that TL was positively correlated with U-Cr, and 8-OHdG and MGMT promoter methylation were positively correlated with RBC-Cr. Multivariate analyses with adjustment for possible confounders showed higher 8-OHdG, TL, and MGMT promoter methylation in exposed workers compared with controls.
Conclusions: Low-to-moderate Cr(VI) exposure was associated with higher oxidative stress, longer telomeres and epigenetic alterations, changes that previously have been linked to lung cancer risk. This study highlights the molecular impacts of Cr(VI) exposure, underscoring the importance of reducing the exposure to Cr(VI).

Authors: Zheshun Jiang, Agneta Runkel, Christian Lindh, Aimonen Kukka, Julia Catalán, Daniela Pineda, Thomas Lundh, Ulla Vogel, Anne T Saber, Martin Tondel, Malin Engfeldt, Annette M Krais, Karin Broberg, SafeChrom Project Team

Full Source: Environmental research 2025 Jun 12:122123. doi: 10.1016/j.envres.2025.122123.

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Inhalational exposures associated with risk of interstitial lung disease: a systematic review and meta-analysis

2025-06-15

Rationale: Inhalational exposures are associated with risk of developing interstitial lung disease (ILD), yet the relationship between specific exposures and ILD is poorly characterised.
Objective: Identify inhalational exposures associated with ILD and estimate the effects of exposures on ILD risk.
Methods: MEDLINE and EMBASE databases were searched from 1990 to 2022 to identify inhalational exposures associated with ILD diagnosis. ILDs where causality is well-established (hypersensitivity pneumonitis, pneumoconiosis) and sarcoidosis were excluded. Two independent reviewers screened abstracts with full-text review and data extraction of eligible studies. Where possible, data were pooled and multilevel meta-analysis was specified using a random effects model. Sources of heterogeneity and risk of bias were assessed.
Main results: 96 studies were included in the systematic review, representing 40 819 116 subjects (295 167 had ILD, 40 523 949 controls). For the meta-analysis, 54 studies were included (40 490 793 subjects: 273 899 ILD, 40 216 894 controls). Exposures associated with significantly increased ILD risk included smoking (OR 1.69, 95% CI 1.47 to 1.94), organic exposures (OR 1.56, 95% CI 1.12 to 2.16), metals (OR 1.52, 95% CI 1.07 to 2.16), dust (OR 1.45, 95% CI 1.20 to 1.76) and asbestos (OR 1.53, 95% CI 1.08 to 2.15). Silica and fumes had positive associations with ILD that trended towards significance.
Conclusions: This systematic review and multilevel meta-analysis is the first to comprehensively assess the effect of inhalational exposures on overall risk of ILD, with multiple putative exposures identified. Future work should investigate novel occupational exposures associated with ILD, characterise the gene-environment interaction and develop preventative strategies.
Prospero registration number: CRD42022292908.

Authors: Cathryn T Lee, Sheiphali A Gandhi, Seham Elmrayed, Hayley Barnes, Diane Lorenzetti, Margaret L Salisbury, Iain D Stewart, Christopher Barber, Cheryl E Peters, Johanna Feary, Kerri A Johannson

Full Source: Thorax 2025 Jun 15:thorax-2024-222306. doi: 10.1136/thorax-2024-222306.