Bulletin Board

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CHEMICAL EFFECTS

An intelligent spectral identification approach for the simultaneous detection of endocrine-disrupting chemicals in aquatic environments

2024-11-13

With the rapid progression of industrialization, the application and release of endocrine disruptors (EDCs), including bisphenol A (BPA), octylphenol and nonylphenol have significantly increased, presenting substantial health hazards. Conventional analytical techniques, such as high-performance liquid chromatography and gas chromatography-mass spectrometry, are highly sophisticated but suffer from complex procedures and high costs. To overcome these limitations, this study introduces an innovative spectral methodology for the simultaneous detection of multiple aquatic multicomponent EDCs. By leveraging chemical machine vision, specifically with convolutional neural network (CNN) models, we employed a long-path holographic spectrometer for rapid, cost-effective identification of BPA, 4-tert-octylphenol, and 4-nonylphenol in aqueous samples. The CNN, refined with the ResNet-50 architecture, demonstrated superior predictive performance, achieving detection limits as low as 3.34, 3.71 and 4.36 μg/L, respectively. The sensitivity and quantification capability of our approach were confirmed through the analysis of spectral image Euclidean distances, while its universality and resistance properties were validated by assessments of environmental samples. This technology offers significantly advantages over conventional techniques in terms of efficiency and cost, offering a novel solution for EDC monitoring in aquatic environments. The implications of this research extend beyond improved detection speed and cost reduction, presenting new methodologies for analyzing complex chemical systems and contributing to environmental protection and public health.

Authors: Liulu Yao, Zhizhi Fu, Qiannan Duan, Mingzhe Wu, Fan Song, Haoyu Wang, Yiheng Qin, Yonghui Bai, Chi Zhou, Xudong Quan, Jianchao Lee
Full Source: Environmental research 2024 Nov 13:120368. doi: 10.1016/j.envres.2024.120368.

With the rapid progression of industrialization, the application and release of endocrine disruptors (EDCs), including bisphenol A (BPA), octylphenol and nonylphenol have significantly increased, presenting substantial health hazards.

Poly-γ-glutamic acid chelates chromium (III) and copper (II), alleviating their toxicity in cucumber and affecting rhizosphere bacterial community assembly

2024-11-14

The accumulation of chromium (Cr) and copper (Cu) in soil during industrialization and modernization poses an extreme threat to crops. Poly-γ-glutamic acid (γ-PGA) has the potential to stabilize heavy metals in soil through chelation because of the numerous carboxyl groups in its side chain. The rhizosphere microbiome contributes to plant detoxification by participating in heavy metal passivation. However, it is still unclear whether γ-PGA can alleviate the toxicity of Cr and Cu to plants and whether this effect is associated with changes in the rhizosphere microbiome assembly. Here, we found that γ-PGA application significantly reduced the content of Cr or Cu in cucumber plants by 67.45%-86.77% and 94.67%-98.21, respectively, and alleviated the oxidative stress of Cr or Cu to plants. Moreover, γ-PGA significantly increased the biomass of cucumber fruits in the plot experiment by 13.5% and 25.3% under Cr and Cu stress, respectively. The content of Cr or Cu in the cucumber fruit was below limits of detection, in contrast to the 31.23 mg/kg Cr or 9.86 mg/kg Cu detected in the no-γ-PGA treatment. γ-PGA effectively chelated Cr and Cu in vitro, and less than 30% of their chelates were degraded in 20 weeks, suggesting the strong stability of these chelates. γ-PGA significantly altered the rhizosphere bacterial community composition of cucumber by enriching phyla Gemmatimonadota, Acidobacteriota and Firmicutes, and genera Gemmatimonas and Stenotrophomonas, which potentially involved in reducing the mobility of Cr and Cu in soils. Furthermore, γ-PGA significantly enriched taxa assigned to plant growth-promoting bacteria (PGPB). Together, our results suggest that γ-PGA can reduce the Cr and Cu contents in cucumber, and this process is strongly associated with the chelation capacity of γ-PGA and its effects on rhizosphere microbiome composition. These results highlight the exciting potential to use γ-PGA for the remediation of heavy metal-contaminated soils.

Authors: Chaoyang Chen, Wenhui Yan, Yu Chen, Sijie Liu, Chuangjiang Nong, Liang Sun, Rui Wang, Hong Xu, Peng Lei, Yian Gu
Full Source: Environmental pollution (Barking, Essex : 1987) 2024 Nov 14:125318. doi: 10.1016/j.envpol.2024.125318.

The accumulation of chromium (Cr) and copper (Cu) in soil during industrialization and modernization poses an extreme threat to crops.

Technical

A novel integrated testing strategy (ITS) for evaluating acute fish toxicity with new approach methodologies (NAMs)

2024-10-31

Acute fish toxicity (AFT) tests are performed in aquatic risk assessments of chemical compounds globally. However, the specific endpoint of in vivo AFT is based on the lethal concentration 50 (LC50), which is a serious challenge in terms of animal welfare. To support the 3Rs principle of replacing, reducing, and refining use of animals, integrated testing strategies (ITS) have recently been developed for environmental risk assessment. ITS efficiently integrates multiple types of information, especially new approach methodologies (NAMs), and further supports regulatory decision-making. Currently, an effective ITS framework for evaluating aquatic toxicity is lacking. Therefore, we aimed to develop a promising ITS for AFT using in silico, in vitro, and in vivo data. We established the ITS via in silico (OECD QSAR Toolbox 4.6), fish cell line acute toxicity (FCT), and fish embryo acute toxicity (FET) tests and then validated the NAMs with AFT testing. The NAM data were derived from the European Chemicals Agency (ECHA) dossier, toxicology databases, peer-reviewed research articles, and this study. For the first step in the ITS process, we aimed to design a high-throughput screening tool to identify non-toxic and toxic chemicals. We found that results of in silico, FCT, and FET tests alone were strongly correlated with AFT. Among the models, the in silico model was most suitable for identifying toxicants due to its high sensitivity and minimal animal use. Next, considering regulatory purposes and flexibility, we determined the predictive LC50 of toxic chemicals by pursuing a preference-dependent strategy, sequential testing strategy, and sensitivity-dependent strategy. All the strategies demonstrated a predictive power equal to or greater than 73%. In addition, to meet user preferences, our ITS approach has high flexibility and supports animal welfare and environmental protection. We have therefore developed multiple powerful, flexible, and more humane ITS methods for acute fish toxicity assessment by integrating NAMs.

Authors: Yen-Ling Lee, Zi-Yu Chen, Tzu-Ning Li, Jian-Feng Hsueh, Ying-Jan Wang

Full Source: Environment international 2024 Oct 31:193:109112. doi: 10.1016/j.envint.2024.109112.

> Acute fish toxicity (AFT) tests are performed in aquatic risk assessments of chemical compounds globally.

Technical

ENVIRONMENTAL RESEARCH

Assessment of heavy metals contamination/pollution of phosphogypsum waste of the Mdhilla region (Gafsa, southern Tunisia)

2024-11-17

Tunisia is currently faced with the extremely delicate problem of managing the millions of tons of phosphogypsum (PG) discharges which is already causing considerable environmental damage. The research carried out in this work is part of a geochemical assessment of the level of heavy metal contamination in phosphogypsum waste from the Mdhilla region (Gafsa, southern Tunisia). The assessment of ETM contamination/pollution is based on the relatively simple principles of measuring concentrations, calculating indices, and comparing them with established standards, which vary according to the nature of the element, its toxicity, and the receiving environment. Six PG samples are taken from the storage heaps right next to the chemical group's plant. Our investigations to assess the level of heavy metals contamination focused on: zinc (Zn), chromium (Cr), copper (Cu), nickel (Ni), and cadmium (Cd). These metallic elements are measured by atomic absorption spectrometry. To achieve our objectives, we calculated several indices, such as the geo-accumulation index (Igeo), the contamination factor (FC), the degree of contamination (DC), and the sediment pollution index (IPS). The index approach enables us to predict the extent of heavy metal pollution in these PG discharges from the Mdhilla region. The Mdhilla region's PG heavy metals contents show the following order of abundance: Zn > Ni > Cr > Cd > Cu. Calculation of contamination/pollution indices reveals in principle polymetallic contamination dominated by three elements: cadmium, nickel, and copper.

Authors: Amor Ben Garali, Sahar Salah, Mohsen Henchiri, Feyda Srarfi
Full Source: Environmental monitoring and assessment 2024 Nov 17;196(12):1204. doi: 10.1007/s10661-024-13383-7.

Assessment of long-term exposure to traffic-related air pollution: An exposure framework

2024-11-16

Background:n Exposure to ambient air pollution is associated with morbidity and mortality, making it an important public health concern. Emissions from motorized traffic are a common source of air pollution but evaluating the contribution of traffic-related air pollution (TRAP) emissions

> Tunisia is currently faced with the extremely delicate problem of managing the millions of tons of phosphogypsum (PG) discharges which is already causing considerable environmental damage.

to health risks is challenging because it is difficult to disentangle the contribution of individual air pollution sources to exposure contrasts in an epidemiological study.

Objective: This paper describes a new framework to identify whether air pollution differences reflect contrasts in TRAP exposures. Because no commonly measured pollutant is entirely specific to on-road motor vehicles, this exposure framework combined information on pollutants, spatial scale (i.e., geographic extent), and exposure assessment methods and their spatial scale to determine whether the estimated effect of air pollution in a given study was related to differences in TRAP.

Methods: The exposure framework extended beyond the near-road environment to include differences in exposure to TRAP at neighborhood resolution (≤ 5 km) across urban, regional, and national scales. It also embedded a stricter set of criteria to identify studies that provided the strongest evidence that exposure contrasts were related to differences in traffic emissions.

Results: Application of the framework to the transparent selection of epidemiological studies for a systematic review produced insights on assessing and improving comparability of TRAP exposure measures, particularly for indirect measures such as distances from roads. It also highlighted study design challenges related to the duration of measurements and the structure of epidemiological models.

Impact statement: This manuscript describes a new exposure framework to identify studies of traffic-related air pollution, a case study of its application in an HEI systematic review, and its implications for exposure science and air pollution epidemiology experts. It identifies challenges and provides recommendations for the field going forward. It is important to bring this information to the attention of researchers in air pollution exposure science and epidemiology because applying the broader lessons learned will improve the conduct and reporting of studies going forward.

Authors: Allison P Patton, Hanna Boogaard, Danielle Vienneau, Jeffrey R Brook, Audrey Smargiassi, Meltem Kutlar Joss, Adam A Szpiro, Sharon K Sagiv, Evangelia Samoli, Barbara Hoffmann, Howard H Chang, Richard W Atkinson, Jennifer Weuve, Francesco Forastiere, Fred W Lurmann, Gerard Hoek

Full Source: Journal of exposure science & environmental epidemiology 2024 Nov 16. doi: 10.1038/s41370-024-00731-5.

Breathing life into equity: How air pollution influences corporate pay gap

2024-11-15

Using a dataset encompassing 19,229 Chinese listed firm-year observations from 2014 to 2020, this study investigates the relationship between air quality and the pay gap between executives and employees. Our empirical results indicate that companies tend to reduce the pay gap in response to air pollution. These results exhibit robustness through various methodological approaches: employing thermal inversion as an instrumental variable (IV) for IV regressions, adopting quantile regressions, utilizing alternative metrics for assessing air pollution and corporate pay gap, expanding control variables, excluding firms undergoing reorganization, and applying firm-level clustering. This effect is especially strong in corporations with greater public scrutiny, strong corporate governance, and fewer financial constraints. Moreover, such strategic adjustments in compensation policies not only help firms retain valuable human resources, but also ultimately enhance their green innovation and ESG performance, as diminished pay gap contribute to fostering increased employee engagement and motivation within the work environment. Our research contributes to environmental management by demonstrating how air quality can be a pivotal factor in corporate compensation strategies. The findings provide actionable insights for executives and policymakers, advocating for the integration of environmental considerations into core business frameworks.

Authors: Weiping Li, Zhongyi Xiao, Yinglin Huang, Haili Wu
Full Source: Journal of environmental management 2024 Nov 15:372:123298. doi: 10.1016/j.jenvman.2024.123298.

PHARMACEUTICAL/TOXICOLOGY

Prenatal exposure to per- and polyfluoroalkyl substances (PFAS) and their influence on inflammatory biomarkers in pregnancy: Findings from the LIFECODES cohort

2024-11-13

Background: Per- and polyfluoroalkyl substances (PFAS) are fluorinated chemicals linked to adverse pregnancy and birth outcomes. However, the underlying mechanisms, specifically their effects on maternal inflammatory processes, are not well characterized.

Objective: We examined associations between prenatal PFAS exposure and repeated measures of inflammatory biomarkers, including C-reactive

Using a dataset encompassing 19,229 Chinese listed firm-year observations from 2014 to 2020, this study investigates the relationship between air quality and the pay gap between executives and employees.

protein (CRP) and four cytokines [Interleukin-10 (IL-10), IL-1β, IL-6, and tumor necrosis factor-α (TNF-α)].

Methods: We analyzed data from 469 pregnant women in a nested case-control study of preterm birth at Brigham and Women's Hospital in Boston, Massachusetts (2006-2008). We measured nine PFAS in early pregnancy plasma samples (median gestation: 10 weeks), with inflammatory biomarkers measured at median gestations of 10, 18, 26, and 35 weeks. We used linear mixed models for repeated measures and multivariable regression for visit-specific analysis to examine associations between each PFAS and inflammation biomarker, adjusting for maternal demographics, pre-pregnancy BMI, and parity. We examined the effects of PFAS mixture using sum of all PFAS (ΣPFAS) and quantile-based g-computation approaches.

Results: We observed consistent inverse associations between most PFAS and cytokines, specifically IL-10, IL-6, and TNF-α, in both single pollutant and mixture analyses. For example, an interquartile range increase in perfluorooctanesulfonic acid was associated with -10.87 (95% CI: -19.75, -0.99), -13.91 (95% CI: -24.11, -2.34), and -8.63 (95% CI: -14.51, -2.35) percent change in IL-10, IL-6, and TNF-α levels, respectively. Fetal sex, maternal race, and visit-specific analyses showed associations between most PFAS and cytokines were generally stronger in mid-pregnancy and among women who delivered males or identified as African American.

Conclusions: The observed suppression of both regulatory (IL-10) and pro-inflammatory (TNF-α) cytokines suggests that PFAS may alter maternal inflammatory processes or immune functions during pregnancy. Further research is needed to understand the effects of both legacy and newer PFAS on inflammatory pathways and their broader clinical implications.

Authors: Ram C Siwakoti, Sean M Harris, Kelly K Ferguson, Wei Hao, David E Cantonwine, Bhramar Mukherjee, Thomas F McElrath, John D Meeker
Full Source: Environment international 2024 Nov 13:194:109145. doi: 10.1016/j.envint.2024.109145.

> Introduction: Per-fluoroalkyl substances (PFAS) are persisting chemicals with endocrine disruptive and carcinogenic properties.

The impact of high exposure to perfluoroalkyl substances and risk for hormone receptor-positive breast cancer - A Swedish cohort study

2024-11-10

Introduction: Perfluoroalkyl substances (PFAS) are persisting chemicals with endocrine disruptive and carcinogenic properties. Previous studies involving cohorts with high PFAS exposure have not shown an increased risk of breast cancer. Research on PFAS and breast cancer according to hormone receptor status is limited. This study aims to investigate the

association between PFAS exposure and hormone receptor-positive breast cancer.

Materials and methods: In 2013, high levels of PFAS (sum of PFAS >10,000 ng/L), dominated by perfluorooctane sulfonic acid (PFOS) and perfluorohexane sulfonic acid (PFHxS) were found in the drinking water from one of the two waterworks in Ronneby, Sweden. Breast cancer diagnoses and information of adjuvant endocrine therapy were retrieved from the Swedish Cancer Register and The Prescribed Drug Register 2006-2016 for a cohort of women residing in the municipality between 1985 and 2013 (n=24,509). Individual exposure was assessed based on municipality waterworks distribution data linked to annual residential addresses. Cox proportional hazards models were used in the analysis. The highest achieved educational level was used as an indicator of socioeconomic position. Sensitivity and subgroup analysis were performed for prepubertal exposure and diagnosis before or after age 50 (assumed menopause).

Results: There were 313 cases of malignant breast cancer among women ≤85 years between 2006 and 2016. Of these, 224 cases (72%) were considered hormone receptor-positive based on the first prescription of adjuvant endocrine therapy, antiestrogens (40%) or aromatase inhibitor (60%). Among women ever living at a residential address with high PFAS exposure, the hazard ratio (HR) for breast cancer classified as hormone receptor-positive was 0.84; 95% confidence interval (CI) 0.61, 1.14. Findings were similar before and after menopause.

Conclusion: High PFAS exposure from drinking water, dominated by PFOS and PFHxS, was not associated with an elevated risk of hormone receptor-positive breast cancer.

Authors: Sofia Hammarstrand, Eva M Andersson, Eva Andersson, Karolina Larsson, Yiyi Xu, Ying Li, Kristina Jakobsson
Full Source: Environment international 2024 Nov 10:193:109140. doi: 10.1016/j.envint.2024.109140.

OCCUPATIONAL

Integrating the lifelong exposure dimension of a chemical mixture into the risk assessment process. Application to trace elements

2024-11-14

Lifelong, the general population is exposed to mixtures of chemicals. Most often, risk assessment is performed to estimate the probability of adverse

> Lifelong, the general population is exposed to mixtures of chemicals.

effects in the population using external exposures to a single chemical and considering one route of exposure. To estimate whole exposure to a chemical, human biomonitoring studies are used to measure chemical concentrations in biological matrices. The limitations of these studies are that is not possible to distinguish the sources or the routes of exposure. Moreover, only the concentrations of a limited number of chemicals are usually determined due to the associated cost. In this study, a methodology has been developed to estimate the internal exposures of the population to a mixture of trace elements (inorganic As, Cd, Pb and Hg) throughout lifetime. This methodology uses realistic lifetime exposure trajectories coupled to physiological based kinetic modeling, considering several sources of exposure. Then, the estimated biomarkers of exposure were compared to human biomonitoring data to estimate the robustness of the methodology. Finally, risk characterization was performed based on the simulated biomarkers of exposure considering an additive effect of chemicals. This methodology allows to determine the contribution of chemicals to the overall risk of renal effect.

Authors: Thomas Gastellu, Bruno Le Bizec, Gilles Rivière
Full Source: Food and chemical toxicology: an international journal published for the British Industrial Biological Research Association 2024 Nov 14:115111. doi: 10.1016/j.fct.2024.115111.

Inhalation Exposure to Cross-linked Polyacrylic Acid Induces Pulmonary Disorders

2024-11-14

Organic polymers, widely used in food, daily necessities, and medicines, include cross-linked polyacrylic acid (CL-PAA), which has been reported to induce severe lung disease. While previous studies mainly used intratracheal instillation, our research focused on inhalation exposure to corroborate these findings. We conducted 5-day (short-term) and 13-week (subchronic) inhalation exposure studies with CL-PAA. In the short-term study, male F344 rats inhaled CL-PAA at 0.2, 2.0, or 20mg/m^3 for 6hours/day over 5 days. Rats were dissected 3 days and 1 month post-exposure. In the subchronic study, rats inhaled CL-PAA at 0.2 or 2.0mg/m^3 for 6hours/day, 5 days/week for 13 weeks, with dissections from 3 days to 6 months post-exposure. To investigate the mechanism of pulmonary disorders, an additional short-term study with 20mg/m^3 CL-PAA included intraperitoneal injections of the antioxidant N-acetylcysteine (NAC) (200mg/kg) with dissection the day after exposure. Short-term exposure led to concentration-dependent increases in neutrophil influx, cytokine-induced neutrophil chemoattractant (CINC), total protein, lactate

Organic polymers, widely used in food, daily necessities, and medicines, include cross-linked polyacrylic acid (CL-PAA), which has been reported to induce severe lung disease.

dehydrogenase (LDH) in bronchoalveolar lavage fluid (BALF), and heme oxygenase-1 (HO-1) in lung tissue. Histopathology showed concentration-dependent neutrophil infiltration. Subchronic exposure caused persistent increases in BALF total protein and lung HO-1, with ongoing neutrophil infiltration and fibrosis. NAC administration reduced neutrophils, total protein, LDH, and CINC in BALF, and HO-1 in lung tissue, improving histopathological findings. Inhalation of CL-PAA caused concentration-dependent lung inflammation and persistent fibrosis. The no observed adverse effect level (NOAEL) for chronic pulmonary disorders was 0.2mg/m^3. Oxidative stress linked to CL-PAA-induced inflammation was mitigated by NAC administration.

Authors: Yasuyuki Higashi, Chinatsu Nishida, Hiroto Izumi, Kazuma Sato, Naoki Kawai, Taisuke Tomonaga, Toshiki Morimoto, Kei Yamasaki, Ke-Yong Wang, Hidenori Higashi, Akihiro Moriyama, Jun-Ichi Takeshita, Takuma Kojima, Kazuo Sakurai, Kazuhiro Yatera, Yasuo Morimoto
Full Source: Toxicology 2024 Nov 14:154001. doi: 10.1016/j.tox.2024.154001.