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CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

CHEMICAL EFFECTS

Nontargeted Screening of Halogenated Organic Compounds in Fish Fillet Tissues from the Great Lakes

2020-11-09

Fish have been used for decades as bioindicators for assessing toxic contaminants in the Great Lakes ecosystem. Routine environmental monitoring programs target predetermined compounds that do not reflect the complete exposure of chemicals to biota and do not provide the complete halogenated fingerprint of the biota. In the current work, a nontargeted screening method was developed using a two-dimensional gas chromatograph coupled to a high-resolution time-of-flight mass spectrometer and was applied to 149 edible fish fillets from different species in the Great Lakes to characterize a more robust set of halogenated organic compounds across species and among lakes. Lake Ontario had the largest number of novel halogenated organic compounds (NHOCs). Seven NHOCs were observed in species from all lakes, indicating that this regional signature was not species-dependent. Hierarchical cluster analysis showed identical NHOC profiles between bottom dwelling and pelagic species. The NHOCs were grouped into seven clusters with similar structures and potentially similar environmental behaviors. Seven of the 29 NHOCs likely containing methoxy or ethoxy groups on a benzene or benzene-methanol backbone were clustered into one group with similar retention times. Five NHOCs were clustered with legacy contaminants that likely have similar structures or are their degradation products.

Authors: Aikebaier Renaguli, Sujan Fernando, Philip K Hopke, Thomas M Holsen, Bernard S Crimmins

Full Source: Environmental science & technology 2020 Nov 9. doi: 10.1021/acs.est.0c05078.

Fish have been used for decades .

Comparative acute toxicity of benzophenone derivatives and bisphenol analogues in the Asian clam Corbicula fluminea

2020-11-07

Among UV-filters, benzophenones are one of the most abundantly used and detected groups in the environment. Bisphenols are also one of the most widely used chemicals in plastics, but their demonstrated deleterious effects on several organisms and humans have led to the production of alternative analogues. However, few comparative studies

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on the ecotoxicological effects of these derivatives or analogues have been carried out. The present study aimed to investigate the effects of two benzophenones (BP-3 and BP-4) and two bisphenols (BPA and BPS) in a short-term exposure of the freshwater endobenthic bivalve Corbicula fluminea. Clams were exposed for 96 h to several concentrations of the four pollutants: BP-3 (0.63; 1.25; 2.5; 5 mg l-1), BP-4 (4.75; 9.5; 19; 38 mg l-1), BPA (3.75; 7.5; 15; 30 mg l-1), and BPS (2.5; 5; 10; 20 mg l-1). The comparative acute toxicity of these pollutants was evaluated by the analysis of the post-exposure filtering capacity of clams, lipid peroxidation (LP) levels and the activity of the antioxidant enzymes catalase (CAT) and glutathione reductase (GR). After the exposure period, except for BP-4, the chemicals tested seemed to be detected by clams and provoked valve closure, decreasing filter-feeding in a concentration-dependent manner. Furthermore, C. fluminea exposed to the highest concentrations of BP-3, BP-4 and BPA showed a significant increase in LP, CAT and GR activities with respect to their controls. BP-3 and BPA were the most toxic compounds showing significant differences in all the parameters analysed at the highest concentrations assayed. However, clams exposed to BPS showed only significant alterations in filtration parameters and in GR activity, in the two highest concentrations tested, indicating that this compound was the least toxic to clams. Obtained results highlight the importance of investigating the effects that emerging pollutants have on aquatic organisms.

Authors: Marta Seoane, Ángeles Cid, Concepción Herrero, Marta Esperanza

Full Source: Ecotoxicology (London, England) 2020 Nov 7. doi: 10.1007/s10646-020-02299-w.

Surfactants are multipurpose products found in most sectors of contemporary industry.

Biosurfactants: The green generation of speciality chemicals and potential production using Solid-State fermentation (SSF) technology

2020-10-24

Surfactants are multipurpose products found in most sectors of contemporary industry. Their large-scale manufacturing has been mainly carried out using traditional chemical processes. Some of the chemical species involved in their production are considered hazardous and some industrial processes employing them categorised as “having potential negative impact on the environment”. Biological surfactants have therefore been generally accepted worldwide as suitable sustainable greener alternatives. Biosurfactants exhibit the same functionalities of synthetic analogues while having the ability to synergize with other molecules improving performances; this strengthens the possibility

of reaching different markets via innovative formulations. Recently, their use was suggested to help combat Covid-19. In this review, an analysis of recent bibliography is presented with descriptions, statistics, classifications, applications, advantages, and challenges; evincing the reasons why biosurfactants can be considered as the chemical specialities of the future. Finally, the uses of the solid-state fermentation as a production technology for biosurfactants is presented.
Authors: Ibrahim M Banat, Quentin Carboué, Gerardo Saucedo-Castañeda, José de Jesús Cázares-Marinero
Full Source: Bioresource technology 2020 Oct 24;320(Pt A):124222. doi: 10.1016/j.biortech.2020.124222.

ENVIRONMENTAL RESEARCH

Review on the fate of antimicrobials, antimicrobial resistance genes, and other micropollutants in manure during enhanced anaerobic digestion and composting

2020-08-14
While manure has been used as nutrient-rich fertilizer for centuries, anaerobic digestion (AD) of manure has only been recognized recently as a promising renewable energy source for producing methane-rich biogas. Various forms of AD have been evaluated for the removal of manure contaminants, such as antimicrobials, antimicrobial resistance genes (ARGs), hormones, and pesticides that pose risks to human health and the environment. Increasing demand for cleaner energy prompts examination of the fate of manure contaminants in conventional and advanced AD techniques. This review reveals that removal of contaminants differs based on type (e.g. antimicrobials vs hormones) or class (e.g. tetracyclines vs sulfonamides) of chemicals being treated. Increasingly, pre-treatment techniques are incorporated into AD systems to enhance biogas production and degrade manure contaminants. For instance, activated carbon with microwave pretreatment removed 87-95% of ARGs. Advanced anaerobic digestion and solid-state anaerobic digestion reduced various ARGs associated with sulfonamides, macrolides, and tetracyclines. Further, total hormone reduction improved using high-temperature pretreatment prior to mesophilic AD. Finally, several studies revealed partial removal of antimicrobials and ARGs during managed composting. Although AD can independently decrease manure contaminants prior to use as fertilizer,

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augmenting AD with composting and other physical treatment processes can further enhance their removal.
Authors: Jena L Congilosi, Diana S Aga
Full Source: Journal of hazardous materials 2020 Aug 14;123634. doi: 10.1016/j.jhazmat.2020.123634.

An all-in-one tool for multipurpose ecological risk assessment and management (MeRAM) of chemical substances in aquatic environment

2020-10-30
A quality-assured ecological risk assessment (ERA) requires enormous resources (time and labor) in collection/assessment of hazard data, as well as considerable expertise to interpret the risk. The ERA of chemicals is thereby considered difficult or impossible for those with little assessment experience and cumbersome or complicated for practitioners. To meet the concerns regarding ERA and accelerate the risk assessment and management of chemicals, we developed an all-in-one free tool for multi-purpose ecological risk assessment management (MeRAM) of chemical substances in aquatic environment called the AIST-MeRAM Ver. 2.0.0 (Copyright No: H28PRO-2007). It allows users from beginners to experts to conduct ERA without any preparation because all the necessary ecotoxicity test data and methodologies are available in the system. Approximately 270,000 ecotoxicity test data points for 3900 chemical substances together with the scientific methodologies from traditional simple hazard quotient (HQ) to more ecologically relevant complicated assessments such as species sensitivity distribution (SSD) and population-level assessment are embedded in the AIST-MeRAM. In addition, users can easily understand the Japanese regulatory RA and management of chemical substances due to a special function based on the Japanese Chemical Substance Control Law (CSCL). Here, we demonstrate a tiered ERA using the embedded sample data to evaluate and ensure the functions of AIST-MERAM. We show that the AIST-MeRAM can provide a comprehensive and accurate ERA, suggesting that it is a powerful IT solution for cumbersome ERA.
Authors: Bin-Le Lin, Yaobin Meng, Masashi Kamo, Wataru Naito
Full Source: Chemosphere 2020 Oct 30;128826. doi: 10.1016/j.chemosphere.2020.128826.

A quality-assured ecological risk assessment (ERA) requires enormous resources (time and labor) in collection/assessment of hazard data, as well as considerable expertise to interpret the risk.

OCCUPATIONAL

Association between H3K36me3 modification and methylation of LINE-1 and MGMT in peripheral blood lymphocytes of PAH-exposed workers

2020-10-01

To explore the epigenetic alterations in response to DNA damage following polycyclic aromatic hydrocarbons (PAHs) exposure and the crosstalk between different epigenetic regulations, we examined trimethylated Lys 36 of histone H3 (H3K36me3) and methylation of 'long interspersed element-1 (LINE-1)' and 'O 6-methylguanine-DNA methyltransferase (MGMT)' in peripheral blood lymphocytes (PBLCs) of 173 coke oven workers (PAH-exposed group) and 94 non-exposed workers (control group). The PAH-exposed group showed higher internal PAH exposure level, enhanced DNA damage and increased MGMT expression (all $P < 0.001$). Notably, the methylation of LINE-1 and MGMT decreased by 3.9 and 40.8%, respectively, while H3K36me3 level was 1.7 times higher in PBLCs of PAH-exposed group compared to control group (all $P < 0.001$). These three epigenetic marks were significantly associated with DNA damage degree (all $P < 0.001$) and PAH exposure level in a dose-response manner (all $P < 0.001$). LINE-1 hypomethylation is correlated with enhanced H3K36me3 modification ($\beta = -0.198$, $P = 0.002$), indicating a synergistic effect between histone modification and DNA methylation at the whole genome level. In addition, MGMT expression was positively correlated with H3K36me3 modification ($r = 0.253$, $P < 0.001$), but not negatively correlated with MGMT methylation ($r = 0.202$, $P < 0.05$). The in vitro study using human bronchial epithelial cells treated with the organic extract of coke oven emissions confirmed that H3K36me3 is important for MGMT expression following PAH exposure. In summary, our study indicates that histone modification and DNA methylation might have synergistic effects on DNA damage induced by PAH exposure at the whole genome level and H3K36me3 is more essential for MGMT expression during the course.

Authors: Xiumei Xing, Zhini He, Ziwei Wang, Ziying Mo, Liping Chen, Boyi Yang, Zhengbao Zhang, Shen Chen, Lizhu Ye, Rui Zhang, Yuxin Zheng, Wen Chen, Daochuan Li

Full Source: Toxicology research 2020 Oct 1;9(5):661-668. doi: 10.1093/toxres/tfaa074.

To explore the epigenetic alterations in response to DNA damage following polycyclic aromatic hydrocarbons (PAHs) exposure and the cross-talk between different epigenetic regulations, we examined trimethylated Lys 36 of histone H3 (H3K36me3) and methylation of 'long interspersed element-1 (LINE-1)' and 'O 6-methylguanine-DNA methyltransferase (MGMT)' in peripheral blood lymphocytes (PBLCs) of 173 coke oven workers (PAH-exposed group) and 94 non-exposed workers (control group).

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Occupational human exposure to mercury in artisanal small-scale gold mining communities of Colombia

2020-11-09

With the aim of protecting human life and the environment, the Minamata Convention seeks to reduce and monitor mercury (Hg) concentrations in the environment. Artisanal and Small-scale Gold Mining (ASGM) has been identified as the most important anthropogenic source of Hg at a global scale and an important route of human exposure to Hg. In this context, this study assessed total Hg (THg) in blood, urine and hair, and methylmercury (MeHg) in human hair samples from 238 participants with occupational exposure to Hg in the most relevant ASGM communities of Colombia. Mercury concentrations in different biological matrices were related to several variables of interest such as age, gender, body mass index, fish consumption, exposure time, and specific occupational activities, such as amalgamation and amalgam burning. The median values of THg in blood (3.70 µg/L), urine (4.00 µg/L) and hair (1.37 mg/kg), and hair MeHg (1.47 mg/kg) for all participants were below permissible concentrations set by WHO. However, about 40% of the miners showed Hg concentrations in blood, urine and/or hair above the WHO thresholds. In all the biological matrices studied, miners burning amalgams showed significantly higher concentrations than miners who did not burn amalgams, with values 7-, 7-, and 8-fold higher in blood, urine and hair, respectively. A multiple linear regression model revealed that burning amalgam and fish consumption were significant predictors of Hg exposure in miners. Miners from Guainía had the highest concentrations in urine and hair, most likely due to the high manipulation and burning of amalgam, and a high fish consumption. In contrast, miners from Caldas showed the lowest Hg concentrations in all the biomarkers because they do not manipulate or burn amalgam, as well as reporting the lowest fish consumption. Our study also highlighted that gold miners exposure to Hg depends on their work practices. Therefore, the implementation of a health education programme on gold mining strategies is required, especially in Guaina, Vaupés, Córdoba, and Antioquia departments.

Authors: Clelia Calao-Ramos, Andrea G Bravo, Roberth Paternina-Uribe, José Marrugo-Negrete, Sergi Díez

Full Source: Environment international 2020 Nov 9;146:106216. doi: 10.1016/j.envint.2020.106216.

With the aim of protecting human life and the environment, the Minamata Convention seeks to reduce and monitor mercury (Hg) concentrations in the environment.

Associations between polyfluoroalkyl substance and organophosphate flame retardant exposures and telomere length in a cohort of women firefighters and office workers in San Francisco

2020-11-07

Background Environmental chemical exposures can affect telomere length, which in turn has been associated with adverse health outcomes including cancer. Firefighters are occupationally exposed to many hazardous chemicals and have higher rates of certain cancers. As a potential marker of effect, we assessed associations between chemical exposures and telomere length in women firefighters and office workers from San Francisco, CA. Methods We measured serum levels of polyfluoroalkyl substances (PFAS), urinary metabolites of flame retardants, including organophosphate flame retardants (OPFRs), and telomere length in peripheral blood leukocytes in women firefighters and office workers who participated in the 2014-15 Women Workers Biomonitoring Collaborative. Multiple linear regression models were used to assess associations between chemical exposures and telomere length. Results Regression results revealed significant positive associations between perfluorooctanoic acid (PFOA) and telomere length and perfluorooctanesulfonic acid (PFOS) and telomere length among the whole cohort. Models stratified by occupation showed stronger and more significant associations among firefighters as compared to office workers. Among firefighters in models adjusted for age, we found positive associations between telomere length and log-transformed PFOA (β(95%CI) = 0.57(0.12, 1.02)), PFOS (0.44 (0.05, 0.83)), and perfluorodecanoic acid (PFDA) (0.43 (0.02, 0.84)). Modeling PFAS as categories of exposure showed significant associations between perfluorononanoic acid (PFNA) and telomere length among firefighters. Significant associations between OPFR metabolites and telomere length were seen for bis(1,3-dichloro-2-propyl) phosphate (BDCPP) and telomere length among office workers (0.21(0.03, 0.40)) and bis(2-chloroethyl) phosphate (BCEP) and telomere length among firefighters (-0.14(-0.28, -0.01)). For OPFRs, the difference in the direction of effect by occupational group may be due to the disparate detection frequencies and levels of exposure between the two groups and/or potential unmeasured confounding. Conclusion Our findings suggest positive associations between PFAS and telomere length in women workers, with larger effects seen among firefighters as compared to office workers. The OPFR metabolites BDCPP and BCEP are also associated with telomere length in

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firefighters and office workers. Associations between chemical exposures and telomere length reported here and by others suggest mechanisms by which these chemicals may affect carcinogenesis and other adverse health outcomes.

Authors: Cassidy Clarity, Jessica Trowbridge, Roy Gerona, Katherine Ona, Michael McMaster, Vincent Bessonneau, Ruthann A Rudel, Heather Buren, Rachel Morello-Frosch

Full Source: medRxiv : the preprint server for health sciences 2020 Nov 7;2020.11.05.20226183. doi: 10.1101/2020.11.05.20226183.

PHARAMACEUTICAL/TOXICOLOGY

Pharmacology-informed prediction of the risk posed to fish by mixtures of non-steroidal anti-inflammatory drugs (NSAIDs) in the environment

2020-11-03

The presence of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised concern that chronic exposure to these compounds may cause adverse effects in wild fish populations. This potential scenario has led some stakeholders to advocate a stricter regulation of NSAIDs, especially diclofenac. Considering their global clinical importance for the management of pain and inflammation, any regulation that may affect patient access to NSAIDs will have considerable implications for public health. The current environmental risk assessment of NSAIDs is driven by the results of a limited number of standard toxicity tests and does not take into account mechanistic and pharmacological considerations. Here we present a pharmacology-informed framework that enables the prediction of the risk posed to fish by 25 different NSAIDs and their dynamic mixtures. Using network pharmacology approaches, we demonstrated that these 25 NSAIDs display a significant mechanistic promiscuity that could enhance the risk of target-mediated mixture effects near environmentally relevant concentrations. Integrating NSAIDs pharmacokinetic and pharmacodynamic features, we provide highly specific predictions of the adverse phenotypes associated with exposure to NSAIDs, and we developed a visual multi-scale model to guide the interpretation of the toxicological relevance of any given set of NSAIDs exposure data. Our analysis demonstrated a non-negligible risk posed to fish by NSAID mixtures in situations of high drug use and low dilution of waste-water treatment plant effluents. We anticipate that this predictive framework will support the future regulatory

The presence of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised concern that chronic exposure to these compounds may cause adverse effects in wild fish populations.

environmental risk assessment of NSAIDs and increase the effectiveness of ecopharmacovigilance strategies. Moreover, it can facilitate the prediction of the toxicological risk posed by mixtures via the implementation of mechanistic considerations and could be readily extended to other classes of chemicals.

Authors: Philip Marmon, Stewart F Owen, Luigi Margiotta-Casaluci

Full Source: Environment international 2020 Nov 3;146:106222. doi: 10.1016/j.envint.2020.106222.

Exposure to per- and polyfluoroalkyl substances and premature skin aging

2020-10-24

Per- and polyfluoroalkyl substances (PFASs) are a ubiquitous group of persistent chemicals distributed globally in the environment. Skin aging is a notorious process that is prematurely induced by the interaction between endogenous and exogenous factors, including exposure to environmental chemicals. The existing evidence suggests that skin absorption of PFASs through dermal contact may be an important route of exposure to these chemicals in humans. On the other hand, PFASs intake by other routes may lead to PFASs bioaccumulation in the skin via tissue bio-distribution. Additionally, the presence of PFASs in consumer and cosmetic products combined with their daily close contact with the skin could render humans readily susceptible to dermal absorption. Therefore, chronic low-dose dermal exposure to PFASs can occur in the human population, representing another important route of exposure to these chemicals. Studies indicate that PFASs can threaten skin health and contribute to premature skin aging. Initiation of inflammatory-oxidative cascades, induction of DNA damage such as telomere shortening, dysregulation of genes engaged in dermal barrier integrity and its functions, signaling of the mitogen activated protein kinase (MAPK) pathway, and last but not least the down-regulation of extracellular matrix (ECM) components are among the most likely mechanisms by which PFASs can contribute to premature skin aging.

Per- and polyfluoroalkyl substances (PFASs) are a ubiquitous group of persistent chemicals distributed globally in the environment.

Authors: Sayed Esmaeil Mousavi, Juana Maria Delgado-Saborit, Lode Godderis

Full Source: Journal of hazardous materials 2020 Oct 24;124256. doi: 10.1016/j.jhazmat.2020.124256.