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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

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Towards deployable electrochemical sensors for per- and polyfluoroalkyl substances (PFAS)

2021-07-29

Per- and polyfluoroalkyl substances (PFAS) are an emerging class of pervasive and harmful environmental micropollutant with negative health effects on humans. Therefore, there has been extensive research into the remediation (i.e., the detection, extraction, and destruction) of these chemicals. For efficient extraction and destruction, PFAS contamination must be detected at its onset; however, conventional PFAS detection methods rely on sample collection and transport to a centralized facility for testing, which is expensive and time-consuming. Electrochemistry offers a robust, inexpensive, and deployable sensing strategy that could detect pollution at its onset; however, the electrochemical inactivity of PFAS necessitates the use of a surface functionalization strategy. Molecularly imprinted polymers (MIPs), which are a popular surface functionalization strategy, have been around since the 1980s for specific electrochemical detection and have expanded electrochemical detection to analytes that are not electrochemically active. MIPs have been more recently demonstrated for the detection of a variety of PFAS species, but additional advances must be made for realization of a deployable, electrochemical MIP-based sensor. This Feature highlights the history of MIPs for PFAS detection and our group's recent advances that are essential to enable the creation of a deployable electrochemical PFAS sensor: development of rigorous analytical standards to quantify interferent effects, miniaturization of the detection platform for quantification in river water, the use of ambient O₂ as the mediator molecule for detection, and the development of hardware for in-field multiplexed electrochemical sensing.

Authors: Rebecca B Clark, Jeffrey E Dick

Full Source: Chemical communications (Cambridge, England) 2021 Jul 29. doi: 10.1039/d1cc02641k.

CHEMICAL EFFECTS

What is in Nigerian waters? Target and non-target screening analysis for organic chemicals

2021-07-15

Emerging organic contaminants (e.g., active pharmaceutical ingredients and personal care products ingredients) are ubiquitous in the environment and potentially harmful to ecosystems, have gained increasing public

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attention worldwide. Nevertheless, there is a scarcity of data on these contaminants in Africa. In this study, various types of water samples (wastewater, surface water and tap water) collected from Lagos, Nigeria were analyzed for these chemicals by both target and non-target analysis on an UHPLC-Orbitrap-MS/MS. In total, 109 compounds were identified by non-target screening using the online database mzCloud. Level 1 identification confidence was achieved for 13 compounds for which reference standards were available and level 2 was achieved for the rest. In the quantitative analysis, 18 of 38 target compounds were detected, including the parent compounds and their metabolites. Acetaminophen, sulfamethoxazole, acesulfame, and caffeine were detected in all samples with their highest concentrations at 8000, 5300, 16, and 7700 µg/L in wastewater, 140000, 3300, 7.7, and 12000 µg/L in surface water, and 66, 62, 0.17 and 1000 µg/L in tap water, respectively. The occurrence of psychoactive substances, anticancer treatments, antiretrovirals, antihypertensives, antidiabetics and their metabolites were reported in Nigeria for the first time. These results indicate poor wastewater treatment and management in Nigeria, and provide a preliminary profile of organic contaminants occurring in Nigerian waters. The findings from this study urge more future research on chemical pollution in the aquatic environments in Nigeria.

Authors: Li-Xin Hu, Olatunde James Olaitan, Zhe Li, Yuan-Yuan Yang, Anyakora Chimezie, Aderonke Ayinke Adepoju-Bello, Guang-Guo Ying, Chang-Er Chen

Full Source: Chemosphere 2021 Jul 15;284:131546. doi: 10.1016/j.chemosphere.2021.131546.

NAC antagonizes arsenic-induced neurotoxicity through TMEM179 by inhibiting oxidative stress in Oli-neu cells

2021-07-28

Arsenic is one of the most common environmental pollutants. Neurotoxicity induced by arsenic has become a major public health concern. However, the effects of arsenic-induced neurotoxicity in the brain and the underlying molecular mechanisms are not well understood. N-acetyl-cysteine (NAC) is a thiol-based antioxidant that can antagonize heavy metal-induced neurotoxicity by scavenging reactive oxygen species (ROS). Here, we used the mouse oligodendrocyte precursor cell (OPC) line Oli-neu to explore the neurotoxic effects of arsenic and the protective effects of NAC. We found that arsenic exposure decreased cell viability, increased oxidative stress, caused mitochondrial dysfunction, and led to apoptosis of Oli-neu cells. Furthermore, we revealed that

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NAC treatment reversed these neurotoxic effects of arsenic. TMEM179, a key membrane protein, was found highly expressed in OPCs and to be an important factor in maintaining mitochondrial functions. We found that TMEM179 played a critical role in mediating the neurotoxic effects of arsenic and the protective role of NAC. PKC β is a downstream factor through which TMEM179 regulates the expression of apoptosis-related proteins. This study improves our understanding of the neurotoxic effects and mechanisms of arsenic exposure and the protective effects of NAC. It also identifies a potential molecular target, TMEM179, for the treatment of arsenic-induced neurotoxicity.

Authors: Zhixin He, Yajing Zhang, Huijie Zhang, Chao Zhou, Qinlong Ma, Ping Deng, Muxue Lu, Zhenlin Mou, Min Lin, Lingling Yang, Yanqi Li, Yang Yue, Huifeng Pi, Yonghui Lu, Mindi He, Lei Zhang, Chunhai Chen, Zhou Zhou, Zhengping Yu

Full Source: Ecotoxicology and environmental safety 2021 Jul 28;223:112554. doi: 10.1016/j.ecoenv.2021.112554.

ENVIRONMENTAL RESEARCH

Detection and removal of poly and perfluoroalkyl polluting substances for sustainable environment

2021-07-26

PFAs (poly and perfluoroalkyl compounds) are hazardous and bioaccumulative chemicals that do not readily biodegrade or neutralize under normal environmental conditions. They have various industrial, commercial, domestic and defence applications. According to the Organization for Economic Co-operation and Development, there are around 4700 PFAs registered to date. They are present in every stream of life, and they are often emerging and are even difficult to be detected by the standard chemical methods. This review aims to focus on the sources of various PFAs and the toxicities they impose on the environment and especially on humankind. Drinking water, food packaging, industrial areas and commercial household products are the primary PFAs sources. Some of the well-known treatment methods for remediation of PFAs presented in the literature are activated carbon, filtration, reverse osmosis, nano filtration, oxidation processes etc. The crucial stage of handling the PFAs occurs in determining and analysing the type of PFA and its remedy. This paper provides a state-of-the-art review of determination & tools, and techniques for remediation of PFAs in the environment. Improving

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new treatment methodologies that are economical and sustainable are essential for excluding the PFAs from the environment.

Authors: Sridhar Pilli, Ashutosh Kumar Pandey, Vivek Pandey, Kritika Pandey, Tulasiram Muddam, Baby Keerthi Thirunagari, Sai Teja Thota, Sunita Varjani, Rajeshwar Dayal Tyagi

Full Source: Journal of environmental management 2021 Jul 26;297:113336. doi: 10.1016/j.jenvman.2021.113336.

Blood Lead Levels and Associated Sociodemographic Factors among Children Aged 3 to 14 Years Living near Zinc and Lead Mines in Two Provinces in Vietnam

2021-07-06

Lead poisoning in children is a major public health concern worldwide, especially in developing countries. We conducted a cross-sectional study on 403 children aged from 3 to 14 years living nearly zinc-lead mining areas in two provinces in Vietnam (Bac Kan and Thai Nguyen) from 06/2016 to 10/2016 to identify risk factors for lead contamination. Results. The proportion of children with blood lead levels (BLLs) $\geq 10 \mu\text{g/dL}$ was 80.51% in Bac Kan and 50% in Thai Nguyen; the mean blood lead level for children was $14.41 \pm 9.42 \mu\text{g/dL}$. In linear regression analyses, the body mass index was negatively associated with elevated BLLs with $r = -0.404$, $p < 0.05$ (95% CI: -0.801, -0.006). In multivariable regression analysis, several risk factors were associated with lead contamination including male sex (aOR = 2.44, 95% CI: 1.13-5.24, $p = 0.02$), play areas in Bac Kan (aOR = 2.3 (1.02-5.17), $p = 0.04$), proximity of children's home of less than 2 kilometers from the mine (aOR = 2.90 (1.54-5.44), $p = 0.001$), and inattentive symptoms in Thai Nguyen (aOR = 7.85, 95% CI 3.49-17.69, $p = 0.001$). Environmental factors, including lead concentrations in the soil and ambient air samples in both locations, are many times higher than Vietnamese standards.

Authors: Thi Giang Hoang, Quang Phuc Tran, Van Tung Lo, Ngoc Hai Doan, Thu Ha Nguyen, Minh Khue Pham

Full Source: BioMed research international 2021 Jul 6;2021:5597867. doi: 10.1155/2021/5597867.

Lead poisoning in children is a major public health concern worldwide, especially in developing countries.

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OCCUPATIONAL

Development of a Data Visualization Tool for Occupational Exposure to Chemicals of Concern for Breast Cancer Among California Working Women, 2010-2014

2021-07-29

We identified the occupations that employ California women and a list of chemicals of concern for breast cancer. We evaluated the likelihood of on-the-job exposure to the categories of chemicals by occupation among formally and informally employed women. We selected 145 occupations representing more than 6.6 million women (85% of California working women), along with an additional sixteen occupations for informal workers only. We organized 1012 chemicals (including mammary gland carcinogens, developmental toxicants, and endocrine-disrupting chemicals) into twenty-five categories. More than 80 percent of occupations investigated had possible or probable exposure to at least one category of chemicals. This is the first categorization of occupational exposure to chemicals of concern for breast cancer among California working women. Our investigation revealed significant data gaps, which could be improved by policy changes resulting in enhanced collection of data on occupation and chemical exposure.

Authors: Stella Beckman, Elana Silver, Justine L Weinberg, Susan Hurley, Matt Frederick, Jacqueline Chan, Peggy Reynolds, Robert Harrison
Full Source: *New solutions : a journal of environmental and occupational health policy* : NS 2021 Jul 29;10482911211032971. doi: 10.1177/10482911211032971.

Endotyping asthma related to three different work exposures

2021-07-28

Background: Work exposures play a significant role in adult-onset asthma, but mechanisms of work-related asthma are not fully elucidated. Objective: We aimed to reveal the molecular mechanisms of work-related asthma associated with flour (FA), isocyanate (IA) or welding fume (WA) exposures and identify potential biomarkers that distinguish these groups from each other. Methods: We used a combination of clinical tests, transcriptomic analysis and associated pathway analyses to investigate underlying disease mechanisms of the blood immune cells and the airway epithelium of 61 men.

We identified the occupations that employ California women and a list of chemicals of concern for breast cancer.

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Results: Compared to the healthy controls, the WA patients had more differentially expressed genes than the FA and IA patients both in the airway epithelia and in the blood immune cells. In the airway epithelia, active inflammation was detected only in WA patients. In contrast, large number of differentially expressed genes were detected in all asthma groups in blood cells. Disease-related immune functions in blood cells were suppressed in all the asthma groups including leukocyte migration and inflammatory responses and decreased expression of upstream cytokines such as TNF and IFN γ . In transcriptome-phenotype correlations, hyperresponsiveness ($R = 0.6$) had the highest clinical relevance and associated with a set of exposure-group specific genes. Finally, biomarker subsets of only 5 genes specifically distinguished each of the asthma exposure group. Conclusions: This study provides novel data on the molecular mechanisms underlying work-related asthma. We identified set of 5 promising biomarkers in asthma related to flour, isocyanate and welding exposure to be tested and clinically validated in future studies.

Authors: Hille Suojalehto, Joseph Ndika, Irmeli Lindström, Liisa Airaksinen, Piia Karisola, Harri Alenius
Full Source: *The Journal of allergy and clinical immunology* 2021 Jul 28;S0091-6749(21)01139-8. doi: 10.1016/j.jaci.2021.07.019.

Workplace noise exposure and the prevalence and 10-year incidence of age-related hearing loss

2021-07-30

There is paucity of population-based data on occupational noise exposure and risk of age-related hearing loss. Therefore, we assessed cross-sectional and longitudinal associations of past workplace noise exposure with hearing loss in older adults. At baseline, 1923 participants aged 50+ years with audiological and occupational noise exposure data included for analysis. The pure-tone average of frequencies 0.5, 1.0, 2.0 and 4.0 kHz (PTA0.5-4KHz) >25 dB HL in the better ear, established the presence of hearing loss. Participants reported exposure to workplace noise, and the severity and duration of this exposure. Prior occupational noise exposure was associated with a 2-fold increased odds of moderate-to-severe hearing loss: multivariable-adjusted OR 2.35 (95% CI 1.45-3.79). Exposure to workplace noise for >10 years increased the odds of having any hearing loss (OR 2.39, 95% CI 1.37-4.19) and moderate-to-severe hearing loss (OR 6.80, 95% CI 2.97-15.60). Among participants reporting past workplace noise exposure at baseline the 10-year incidence of hearing loss was 35.5% versus 29.1% in those who had no workplace noise exposure. Workplace

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noise exposure was associated with a greater risk of incident hearing loss during the 10-year follow-up: multivariable-adjusted OR 1.39 (95% CI 1.13-1.71). Prior occupational noise exposure was not associated with hearing loss progression. Workplace noise exposure increased the risk of incident hearing loss in older adults. Our findings underscore the importance of preventive measures which diminish noise exposure in the workplace, which could potentially contribute towards reducing the burden of hearing loss in later life.

Authors: Bamini Gopinath, Catherine McMahon, Diana Tang, George Burlutsky, Paul Mitchell

Full Source: PloS one 2021 Jul 30;16(7):e0255356. doi: 10.1371/journal.pone.0255356.

Perceptions of heat-health impacts and the effects of knowledge and preventive actions by outdoor workers in Hanoi, Vietnam

2021-06-10

Extreme heat is an increasing climate threat, most pronounced in urban areas where poor populations are at particular risk. We analyzed heat impacts and vulnerabilities of 1027 outdoor workers who participated in a KAP survey in Hanoi, Vietnam in 2018, and the influence of their mitigation actions, their knowledge of heat-risks, and access to early warnings. We grouped respondents by their main income (vendors, builders, shippers, others, multiple jobs, and non-working) and analyzed their reported heat-health impacts, taking into consideration socioeconomics, knowledge of heat impacts and preventive measures, actions taken, access to air-conditioning, drinking amounts and use of weather forecasts. We applied linear and logistic regression analyses using R. Construction workers were younger and had less knowledge of heat-health impacts, but also reported fewer symptoms. Older females were more likely to report symptoms and visit a doctor. Access to air-conditioning in the bedroom depended on age and house ownership, but did not influence heat impacts as cooling was too expensive. Respondents who knew more heat exhaustion symptoms were more likely to report impacts ($p < 0.01$) or consult a doctor ($p < 0.05$). Similarly, those who checked weather updates were more likely to report heat impacts ($p < 0.01$) and experienced about 0.6 more symptoms ($p < 0.01$). Even though occupation type did not explain heat illness, builders knew considerably less (40%; $p < 0.05$) about heat than other groups but were twice as likely to consult a doctor than street vendors ($p < 0.01$). Knowledge of preventive actions and taking these actions both correlated positively with reporting of heat-health symptoms, while drinking water

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did not reduce these symptoms ($p < 0.01$). Child carers and homeowners experienced income losses in heatwaves ($p < 0.01$). The differences support directed actions, such as dissemination of educational materials and weather forecasts for construction workers. The Red Cross assisted all groups with cooling tents, provision of drinks and health advice.

Authors: S Lohrey, M Chua, C Gros, J Faucet, J K W Lee

Full Source: The Science of the total environment 2021 Jun 10;794:148260. doi: 10.1016/j.scitotenv.2021.148260.

PHARMACEUTICAL/TOXICOLOGY

Benzo(a)pyrene exposure in utero exacerbates Parkinson's Disease (PD)-like α -synucleinopathy in A53T human alpha-synuclein transgenic mice

2021-07-28

Background: Previous work indicated that benzo[a]pyrene (B(a)P) exposure in utero might adversely affect neurodevelopment and cause Parkinson's Disease (PD)-like symptoms. However, the effect of utero exposure to B(a)P on PD-like α -synucleinopathy and the mechanism under are unclear. Objective: The A53T human alpha-synuclein (α -syn) transgenic mice (M83+/-) were used in this study to gain insights into the role of B(a)P exposure in utero in the onset of α -syn pathology and neuronal damage. Method: Timed-pregnant M83+/- dams were exposed to 1) corn oil (vehicle) or 2) 5 mg/kg bw/d B(a)P or 3) 20 mg/kg bw/d B(a)P at gestational day 10-17 by oral gavage and then the SNCA transcription, α -syn accumulation and aggregation, neuroinflammation and nigral dopaminergic neurodegeneration of 60-day-old pups were evaluated. Result: SNCA mRNA and α -syn protein expression in the midbrain of 60 days adult mice were found to be remarkably elevated after B(a)P exposure in utero, the protein degradation capacity was injured (in 20 mg/kg dose group) and α -syn aggregation could be observed in the substantia nigra (SN); Enhanced Iba1 expression in the midbrain and microglial activation (in 20 mg/kg dose group) in the SN were also figured out; Besides, dopaminergic neurons in the SN of 60 days adult mice were significantly decreased. Conclusions: Our findings demonstrated that B(a)P exposure in utero could exacerbate α -syn pathology and induce

Background: Previous work indicated that benzo[a]pyrene (B(a)P) exposure in utero might adversely affect neurodevelopment and cause Parkinson's Disease (PD)-like symptoms.

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activation of microglia which might further lead to dopaminergic neuronal loss in the SN.

Authors: Weixing Xu, Yuze Qi, Yanjun Gao, Huihui Quan, Qingru Li, Hui Zhou, Jing Huang

Full Source: Toxicology and applied pharmacology 2021 Jul 28;115658. doi: 10.1016/j.taap.2021.115658.