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CHEMICAL EFFECTS

Prevalence of microplastics in commercially sold soft drinks and human risk assessment

2023-03-10

Due to the increasing global plastic production and use in recent years, the amount of microplastic (MP) accumulating in the environment has also increased. This microplastic pollution potential has been documented mostly in studies of the sea or seafood. The presence of microplastics in terrestrial foods has therefore attracted less attention, despite the potential for future major environmental risks. Some of these researches are related to bottled water, tap water, honey, table salt, milk, and soft drinks. However, the presence of microplastics in soft drinks has not yet been evaluated in the European continent, including Türkiye. Hence, the current study focused on the presence and distribution of microplastics in ten soft drink brands in Türkiye since the water utilized in the bottling process of soft drinks originates from different water supply sources. Using FTIR stereoscopy and stereomicroscope examination, MPs were detected in all of these brands. According to the microplastic contamination factor (MPCF) classification, 80% of the soft drink samples indicated a high level of contamination with microplastics. The study's findings showed that each liter of consumed soft drinks exposes people to about nine microplastic particles, which is a moderate dose when compared to exposure levels in earlier research. It has been determined that bottle-production processes and the substrates used for food production may be the main sources of these microplastics. The chemical components of these microplastic polymers were polyamide (PA), polyethylene terephthalate (PET) and polyethylene (PE), and fibers were the dominant shape. Compared to adults, children were subjected to higher microplastic loads. The study's preliminary data on MP contamination of soft drinks may be useful for further evaluating the risks exposure to microplastics poses to human health.

Authors: Abdullah Altunışık

Full Source: Journal of environmental management 2023 Mar 10;336:117720. doi: 10.1016/j.jenvman.2023.117720.

Due to the increasing global plastic production and use in recent years, the amount of microplastic (MP) accumulating in the environment has also increased.

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Combined toxic effects of environmental predominant microplastics and ZnO nanoparticles in freshwater snail Pomaceae paludosa

2023-03-10

In the past few years, microplastics are one of the ubiquitous threatening pollutants in aquatic habitats. These persistent microplastics interact with other pollutants, especially nanoparticles were adherent on the surface, which causes potential hazards in the biota. In this study, the toxic effects of individual and combined (28 days) exposure with zinc oxide nanoparticles and polypropylene microplastics were assessed in freshwater snail Pomeacea paludosa. After the experiment, the toxic effect was evaluated by the estimation of vital biomarkers activities including antioxidant enzymes (superoxide dismutase (SOD), catalase (CAT), glutathione S-transferase (GST), oxidative stress in carbonyl protein (CP), lipid peroxidation (LPO), and digestive enzymes (esterase and alkaline phosphatase). Chronic exposure to pollutants in snails causes increased reactive oxygen species level (ROS) and generates free radicals in their body which leads to impairment and alterations of biochemical markers. Where alteration in acetylcholine esterase (AChE) activity and decreased digestive enzymes (esterase and alkaline phosphatase) activities were observed in both individual and combined exposed groups. Further, histology results revealed the reduction of haemocyte cells, the disintegration of blood vessels, digestive cells, calcium cells, and DNA damage was also detected in the treated animals. Overall, when compared to individual exposures, combined exposure of pollutants (zinc oxide nanoparticles and polypropylene microplastics) causes more serious harms including decline and increased antioxidant enzyme parameters, damage the protein and lipids by oxidative stress, increased neurotransmitter activity, decrease digestive enzyme activities in the freshwater snail. The outcome of this study concluded that polypropylene microplastics along with nanoparticles cause severe ecological threats and physio-chemical effects on the freshwater ecosystem.

Authors: Jeyaraj Jeyavani, Baskaralingam Vaseeharan

Full Source: Environmental pollution (Barking, Essex : 1987) 2023 Mar 10;121427. doi: 10.1016/j.envpol.2023.121427.

In the past few years, microplastics are one of the ubiquitous threatening pollutants in aquatic habitats.

Phytotoxicity of Bisphenol A to Allium cepa Root Cells Is Mediated through Growth Hormone Gibberellic Acid and Reactive Oxygen Species

2023-02-22

The aim of this study was to test the phytotoxicity and mode of action of bisphenol A (BPA) on Allium cepa using a multibiomarker approach. A. cepa roots were exposed to BPA in concentration range 0-50 mg L-1 for 3 days. BPA even in the lowest applied concentration (1 mg L-1) reduced root length, root fresh weight, and mitotic index. Additionally, the lowest BPA concentration (1 mg L-1) decreased the level of gibberellic acid (GA3) in root cells. BPA at concentration 5 mg L-1 increased production of reactive oxygen species (ROS) that was followed by increase in oxidative damage to cells' lipids and proteins and activity of enzyme superoxide dismutase. BPA in higher concentrations (25 and 50 mg L-1) induced genome damage detected as an increase in micronucleus (MNs) and nuclear buds (NBUDs). BPA at >25 mg L-1 induced synthesis of phytochemicals. Results of this study using multibiomarker approach indicate that BPA is phytotoxic to A. cepa roots and has shown genotoxic potential to plants, thus its presence in the environment should be monitored.

Authors: Valerija Vujčić Bok, Marko Gerić, Goran Gajski, Sanja Gagić, Ana-Marija Domijan

Full Source: Molecules (Basel, Switzerland) 2023 Feb 22;28(5):2046. doi: 10.3390/molecules28052046.

The aim of this study was to test the phyto-toxicity and mode of action of bisphenol A (BPA) on Allium cepa using a multibio-marker approach.

ENVIRONMENTAL RESEARCH

EU need to protect its environment from toxic per- and polyfluoroalkyl substances

2023-03-09

The Environmental Protection Agencies (EPAs) of Denmark, Sweden, Norway, Germany and the Netherlands submitted a proposal to the European Chemical Agency (ECHA) in February 2023 calling for a ban in the use of toxic industrial chemicals per- and polyfluoroalkyl substances (PFAS). These chemicals are highly toxic causing elevated cholesterol, immune suppression, reproductive failure, cancer and neuro-endocrine disruption in humans and wildlife being a significant threat to biodiversity and human health. The main reason for the submitted proposal is recent findings of significant flaws in the transition to PFAS replacements that is leading to a widespread pollution. Denmark was the first country

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banning PFAS, and now other EU countries support the restrictions of these carcinogenic, endocrine disruptive and immunotoxic chemicals. The proposed plan is among the most extensive received by the ECHA for 50 years. Denmark is now the first EU country to initiate the establishment of groundwater parks to try and protect its drinking water. These parks are areas free of agricultural activities and nutritious sewage sludge to secure drinking water free of xenobiotic including PFAS. The PFAS pollution also reflects the lack of comprehensive spatial and temporal environmental monitoring programs in the EU. Such monitoring programs should include key indicator species across ecosystems of livestock, fish and wildlife, to facilitate detection of early ecological warning signals and sustain public health. Simultaneously with inferring a total PFAS ban, the EU should also push for more persistent, bioaccumulative and toxic (PBT) PFAS substances to be listed on the Stockholm Convention (SC) Annex A such as PFOS (perfluorooctane sulfonic acid) that is currently listed on the SCs Annex B. The combination of these regulative restrictions combined with groundwater parks and pan-European biomonitoring programs, would pave the way forward for a cleaner environment to sustain health across the EU.

Authors: Christian Sonne, Bjørn M Jenssen, Jörg Rinklebe, Su Shiung Lam, Martin Hansen, Rossana Bossi, Kim Gustavson, Rune Dietz

Full Source: The Science of the total environment 2023 Mar 9;162770. doi: 10.1016/j.scitotenv.2023.162770.

Possible accumulation of critical metals in plants that hyperaccumulate their chemical analogues?

2023-03-10

Lithium (Li), gallium (Ga) and indium (In) are industry-critical metals, with no known plant species that (hyper)accumulate these metals to any substantial degree. We hypothesised that sodium (Na) hyperaccumulators (i.e., halophytes) may accumulate Li, whilst aluminium (Al) hyperaccumulators may accumulate Ga and In, based on the chemical similarities of these elements. Experiments were conducted in hydroponics at various molar ratios for six weeks to determine accumulation in roots and shoots of the target elements. For the Li experiment, the halophytes Atriplex amnicola, Salsola australis and Tecticornia pergranulata were subjected to Na and Li treatments, whilst for the Ga and In experiment, Camellia sinensis was exposed to Al, Ga, and In. The halophytes were able to accumulate high shoot Li and Na concentrations reaching up to ~10 g Li kg-1 and 80 g Na kg-1, respectively. The translocation factors for Li were higher than for Na (about two-fold) in A. amnicola and S. australis.

Lithium (Li), gallium (Ga) and indium (In) are industry-critical metals, with no known plant species that (hyper)accumulate these metals to any substantial degree.

The results from the Ga and In experiment show that C. sinensis is capable of accumulating high concentrations of Ga (mean 150 mg Ga kg-1), comparable with Al (mean 300 mg Al kg-1), but virtually no In (<20 mg In kg-1) in its leaves. Competition between Al and Ga suggests that Ga might be taken up via Al pathways in C. sinensis. The findings suggest that there are opportunities to explore Li and Ga phytomining on respective Li- and Ga-enriched mine water/soil/mine waste materials using halophytes and Al hyperaccumulators to complement the global supply of these critical metals.

Authors: Philip Nti Nkrumah, Antony van der Ent

Full Source: The Science of the total environment 2023 Mar 10;162791. doi: 10.1016/j.scitotenv.2023.162791.

Methodological advances and future directions of microalgal bioassays for evaluation of potential toxicity in environmental samples: A review

2023-03-07

Microalgal bioassays are widely applied to evaluate the potential toxicity of various persistent toxic substances in environmental samples due to multiple advantages, including high sensitivity, short test duration, and cost-effectiveness. Microalgal bioassay is gradually developing in method, and the scope of application to environmental samples is also expanding. Here, we reviewed the published literature on microalgal bioassays for environmental assessments, focusing on types of samples, sample preparation methods, and endpoints, and highlighted key scientific advancements. Bibliographic analysis was performed with the keywords 'microalgae' and 'toxicity' or 'bioassay', and 'microalgal toxicity'; 89 research articles were selected and reviewed. Traditionally, most studies implementing microalgal bioassays focused on water samples (44%) with passive samplers (38%). Studies using the direct exposure method (41%) of injecting microalgae into sampled water mainly evaluated toxic effects by growth inhibition (63%). Recently, various automated sampling techniques, in situ bioanalytical methods with multiple endpoints, and targeted and non-targeted chemical analyses have been applied. More research is needed to identify causative toxicants affecting microalgae and to quantify the cause-effect relationships. This study provides the first comprehensive overview of recent advances in microalgal bioassays

Microalgal bioassays are widely applied to evaluate the potential toxicity of various persistent toxic substances in environmental samples due to multiple advantages, including high sensitivity, short test duration, and cost-effectiveness.

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performed with environmental samples, suggesting future research directions based on current understanding and limitations.

Authors: Junghyun Lee, Seongjin Hong, Seong-Ah An, Jong Seong Khim

Full Source: Environment international 2023 Mar 7;173:107869. doi: 10.1016/j.envint.2023.107869.

Source, occurrence, distribution, fate, and implications of microplastic pollutants in freshwater on environment: A critical review and way forward

2023-03-10

The generation of microplastics (MPs) has increased recently and become an emerging issue globally. Due to their long-term durability and capability of traveling between different habitats in air, water, and soil, MPs presence in freshwater ecosystem threatens the environment with respect to its quality, biotic life, and sustainability. Although many previous works have been undertaken on the MPs pollution in the marine system recently, none of the study has covered the scope of MPs pollution in the freshwater. To consolidate scattered knowledge in the literature body into one place, this work identifies the sources, fate, occurrence, transport pathways, and distribution of MPs pollution in the aquatic system with respect to their impacts on biotic life, degradation, and detection techniques. This article also discusses the environmental implications of MPs pollution in freshwater ecosystems. Certain techniques for identifying MPs and their limitations in applications are presented. Through a literature survey of 274 published articles (2000-2022), this study presents an overview of solutions to the MP pollution, while identifying research gaps in the body of knowledge for further work. It is conclusive from this review that the MPs exist in the freshwater due to an improper littering of plastic waste and its degradation into smaller particles. Approximately 15-51 trillion MP particles have accumulated in the oceans with their weight ranging between 93,000 and 236,000 metric ton (Mt), while about 19-23 Mt of plastic waste was released into rivers in 2016, which is projected to increase up to 53 Mt by 2030. A subsequent degradation of MPs in the aquatic environment results in the generation of NPs with size ranging from 1 to 1000 nm. It is expected that this facilitates stakeholders to understand the multi-aspects of MPs pollution in the freshwater and recommends policy actions to implement sustainable solutions to this environmental problem.

Authors: Tonni Agustiono Kurniawan, Ahtisham Haider, Hafiz Muhammad Ahmad, Ayesha Mohyuddin, Hafiz Muhammad Umer Aslam, Sohail

The generation of microplastics (MPs) has increased recently and become an emerging issue globally.

Nadeem, Mohsin Javed, Mohd Hafiz Dzarfan Othman, Hui Hwang Goh, Kit Wayne Chew
Full Source: Chemosphere 2023 Mar 10;138367. doi: 10.1016/j.chemosphere.2023.138367.

PHARMACEUTICAL/TOXICOLOGY

Ecotoxicological QSAR study of fused/non-fused polycyclic aromatic hydrocarbons (FNFPAHs): Assessment and priority ranking of the acute toxicity to Pimephales promelas by QSAR and consensus modeling methods

2023-03-10
Fused/non-fused polycyclic aromatic hydrocarbons (FNFPAHs) have a variety of toxic effects on ecosystems and human body, but the acquisition of their toxicity data is greatly limited by the limited resources available. Here, we followed the EU REACH regulation and used Pimephales promelas as a model organism to investigate the quantitative structure-activity relationship (QSAR) between the FNFPAHs and their toxicity for the aquatic environment for the first time. We developed a single QASR model (SM1) containing five simple and interpretable 2D molecular descriptors, which met the validation of OECD QSAR-related principles, and analyzed their mechanistic relationships with toxicity in detail. The model had good degree of fitting and robustness, and had better external prediction performance (MAEtest = 0.4219) than ECOSAR model (MAEtest = 0.5614). To further enhance its prediction accuracy, the three qualified single models (SMs) were used for constructing consensus models (CMs), the best one CM2 (MAEtest = 0.3954) had a significantly higher prediction accuracy for test compounds than SM1, and also outperformed the T.E.S.T. consensus model (MAEtest = 0.4233). Subsequently, the toxicity of 252 true external FNFPAHs from Pesticide Properties Database (PPDB) was predicted by SM1, the prediction results showed that 94.84 % compounds were reliably predicted within the model's application domain (AD). We also applied the best CM2 to predict the untested 252 FNFPAHs. Furthermore, we provided a mechanistic analysis and explanation for pesticides ranked as top 10 most toxic FNFPAHs. In summary, all developed QSAR and consensus models can be used as efficient tools for predicting the acute toxicity of unknown FNFPAHs to Pimephales promelas, thus being important for the risk assessment and regulation of FNFPAHs contamination in aquatic environment.

Fused/non-fused polycyclic aromatic hydrocarbons (FNFPAHs) have a variety of toxic effects on ecosystems and human body, but the acquisition of their toxicity data is greatly limited by the limited resources available.

Authors: Shuo Chen, Guohui Sun, Tengjiao Fan, Feifan Li, Yuancong Xu, Na Zhang, Lijiao Zhao, Rugang Zhong
Full Source: The Science of the total environment 2023 Mar 10;162736. doi: 10.1016/j.scitotenv.2023.162736.

OCCUPATIONAL

Exposure to non-persistent pesticides and sexual maturation of Spanish adolescent males

2023-03-10
Background: Several non-persistent pesticides are endocrine disrupting chemicals and may impact on sexual maturation.
Objective: To examine the association between urinary biomarkers of non-persistent pesticides and sexual maturation in adolescent males in the Environment and Childhood (INMA) Project.
Methods: The metabolites of several pesticides were measured in spot urine samples collected from 201 boys aged 14-17 years, including: 3,5,6-trichloro-2-pyridinol (TCPy), metabolite of chlorpyrifos; 2-isopropyl-4-methyl-6-hydroxypyrimidine (IMPy), metabolite of diazinon; malathion diacid (MDA), metabolite of malathion; diethyl thiophosphate (DETP) and diethyl dithiophosphate, non-specific metabolites of organophosphates; 3-phenoxybenzoic acid (3-PBA) and dimethyl cyclopropane carboxylic acid, metabolites of pyrethroids; 1-naphthol (1-NPL), metabolite of carbaryl; and ethylene thiourea (ETU), metabolite of dithiocarbamate fungicides. Sexual maturation was assessed using Tanner stages, self-reported Pubertal Development Scale, and testicular volume (TV). Multivariate logistic regression was employed to examine associations between urinary pesticide metabolites and the odds of being in Tanner stage 5 of genital development (G5) or pubic hair growth (PH5); stage ≥4 of overall pubertal development, gonadarche, and adrenarche; or having mature TV (≥25 mL).
Results: DETP concentrations>75th percentile (P75) were associated with lower odds of being in stage G5 (OR = 0.27; 95% CI = 0.10-0.70), detectable TCPy with lower odds of gonadal stage≥4 (OR = 0.50; 95% CI = 0.26-0.96), and intermediate detectable MDA concentrations (<P75) with lower odds of adrenal stage≥4 (OR = 0.32; 95% CI = 0.11-0.94). Conversely, detectable concentrations of 1-NPL were associated with higher odds of adrenal stage≥4 (OR = 2.61; 95% CI = 1.30-5.24) but lower odds of mature TV (OR = 0.42; 95% CI = 0.19-0.90).

Background: Several non-persistent pesticides are endocrine disrupting chemicals and may impact on sexual maturation.
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Conclusion: Exposure to certain pesticides may be associated with delayed sexual maturity in adolescent males.
Authors: Francesca Castiello, Beatriz Suárez, José Gómez-Vida, Maties Torrent, Mariana F Fernández, Nicolás Olea, Carmen Freire
Full Source: Chemosphere 2023 Mar 10;138350. doi: 10.1016/j.chemosphere.2023.138350.

Intermittent Lead Exposure Induces Behavioral and Cardiovascular Alterations Associated with Neuroinflammation

2023-03-06
The nervous system is the primary target for lead exposure and the developing brain appears to be especially susceptible, namely the hippocampus. The mechanisms of lead neurotoxicity remain unclear, but microgliosis and astrogliosis are potential candidates, leading to an inflammatory cascade and interrupting the pathways involved in hippocampal functions. Moreover, these molecular changes can be impactful as they may contribute to the pathophysiology of behavioral deficits and cardiovascular complications observed in chronic lead exposure. Nevertheless, the health effects and the underlying influence mechanism of intermittent lead exposure in the nervous and cardiovascular systems are still vague. Thus, we used a rat model of intermittent lead exposure to determine the systemic effects of lead and on microglial and astroglial activation in the hippocampal dentate gyrus throughout time. In this study, the intermittent group was exposed to lead from the fetal period until 12 weeks of age, no exposure (tap water) until 20 weeks, and a second exposure from 20 to 28 weeks of age. A control group (without lead exposure) matched in age and sex was used. At 12, 20 and 28 weeks of age, both groups were submitted to a physiological and behavioral evaluation. Behavioral tests were performed for the assessment of anxiety-like behavior and locomotor activity (open-field test), and memory (novel object recognition test). In the physiological evaluation, in an acute experiment, blood pressure, electrocardiogram, and heart and respiratory rates were recorded, and autonomic reflexes were evaluated. The expression of GFAP, Iba-1, NeuN and Synaptophysin in the hippocampal dentate gyrus was assessed. Intermittent lead exposure induced microgliosis and astrogliosis in the hippocampus of rats and changes in behavioral and cardiovascular function. We identified increases in GFAP and Iba1 markers together with presynaptic dysfunction in the hippocampus, concomitant with behavioral changes. This type of exposure produced significant long-term memory dysfunction.

The nervous system is the primary target for lead exposure and the developing brain appears to be especially susceptible, namely the hippocampus.

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Regarding physiological changes, hypertension, tachypnea, baroreceptor reflex impairment and increased chemoreceptor reflex sensitivity were observed. In conclusion, the present study demonstrated the potential of lead intermittent exposure inducing reactive astrogliosis and microgliosis, along with a presynaptic loss that was accompanied by alterations of homeostatic mechanisms. This suggests that chronic neuroinflammation promoted by intermittent lead exposure since fetal period may increase the susceptibility to adverse events in individuals with pre-existing cardiovascular disease and/or in the elderly.
Authors: Liana Shvachiy, Ângela Amaro-Leal, Tiago F Outeiro, Isabel Rocha, Vera Geraldes
Full Source: Cells 2023 Mar 6;12(5):818. doi: 10.3390/cells12050818.