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CHEMICAL EFFECTS

Ecotoxicity of Heteroaggregates of Polystyrene Nanospheres in Chironomidae and Amphibian

2022-08-08

Due to their various properties as polymeric materials, plastics have been produced, used and ultimately discharged into the environment. Although some studies have shown their negative impacts on the marine environment, the effects of plastics on freshwater organisms are still poorly studied, while they could be widely in contact with this pollution. The current work aimed to better elucidate the impact and the toxicity mechanisms of two kinds of commercial functionalized nanoplastics, i.e., carboxylated polystyrene microspheres of, respectively, 350 and 50 nm (PS350 and PS50), and heteroaggregated PS50 with humic acid with an apparent size of 350 nm (PSHA), all used at environmental concentrations (0.1 to 100 $\mu\text{g L}^{-1}$). For this purpose, two relevant biological and aquatic models-amphibian larvae, *Xenopus laevis*, and dipters, *Chironomus riparius*-were used under normalized exposure conditions. The acute, chronic, and genetic toxicity parameters were examined and discussed with regard to the fundamental characterization in media exposures and, especially, the aggregation state of the nanoplastics. The size of PS350 and PSHA remained similar in the *Xenopus* and *Chironomus* exposure media. Inversely, PS50 aggregated in both exposition media and finally appeared to be micrometric during the exposition tests. Interestingly, this work highlighted that PS350 has no significant effect on the tested species, while PS50 is the most prone to alter the growth of *Xenopus* but not of *Chironomus*. Finally, PSHA induced a significant genotoxicity in *Xenopus*.

Authors: Florence Mouchet, Laura Roweczyk, Antoine Minet, Fanny Clergeaud, Jérôme Silvestre, Eric Pinelli, Jessica Ferriol, Joséphine Leflaive, Loïc Ten-Hage, Julien Gigault, Alexandra Ter Halle, Laury Gauthier
Full Source: *Nanomaterials* (Basel, Switzerland) 2022 Aug 8;12(15):2730. doi: 10.3390/nano12152730.

DNA Oxidative Damage as a Sensitive Genetic Endpoint to Detect the Genotoxicity Induced by Titanium Dioxide Nanoparticles

2022-07-29

The genotoxicity of nanomaterials has attracted great attention in recent years. As a possible occupational carcinogen, the genotoxic effects and underlying mechanisms of titanium dioxide nanoparticles (TiO₂ NPs)

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have been of particular concern. In this study, the effect of TiO₂ NPs (0, 25, 50 and 100 $\mu\text{g/mL}$) on DNA damage and the role of oxidative stress were investigated using human bronchial epithelial cells (BEAS-2B) as an in vitro model. After detailed characterization, the cytotoxicity of TiO₂ NPs was detected. Through transmission electron microscopy (TEM), we found that TiO₂ NPs entered the cytoplasm but did not penetrate deep into the nucleus of cells. The intracellular levels of reactive oxygen species (ROS) significantly increased in a dose-dependent manner and the ratios of GSH/GSSG also significantly decreased. The results of the normal comet assay were negative, while the Fpg-modified comet assay that specifically detected DNA oxidative damage was positive. Meanwhile, N-acetyl-L-cysteine (NAC) intervention inhibited the oxidative stress and genotoxicity induced by TiO₂ NPs. Therefore, it was suggested that TiO₂ NPs could induce cytotoxicity, oxidative stress and DNA oxidative damage in BEAS-2B cells. DNA oxidative damage may be a more sensitive genetic endpoint to detect the genotoxicity of TiO₂ NPs.

Authors: Zhangjian Chen, Jiaqi Shi, Yi Zhang, Shuo Han, Jiahe Zhang, Guang Jia

Full Source: *Nanomaterials* (Basel, Switzerland) 2022 Jul 29;12(15):2616. doi: 10.3390/nano12152616.

Sublethal Exposure to Cadmium Induces Chemosensory Dysfunction in Fire Ants

2022-08-09

Ants easily accumulate cadmium (Cd) from the food web in terrestrial ecosystems. Cd contamination may cause olfactory dysfunction and consequently disorders in the social behavior of ants. To explore the molecular mechanism underlying the effect of Cd exposure on the chemosensory process of ants, we characterized the Cd-induced variations in the expression of genes involved in chemoreception and electrophysiological and behavioral sensitivity to semiochemicals by using the red imported fire ant, *Solenopsis invicta*, as a model system. As a result, Cd exposure increased Cd accumulation and decreased the survival rate of *S. invicta*. Cd exposure altered the expression profiles of odor binding protein genes of *S. invicta* (SiOBPs). Specifically, SiOBP15 protein expression was upregulated upon Cd exposure. Both SiOBP7 and SiOBP15 exhibited high binding affinities to limonene, nonanal, and 2,4,6-trimethylpyridine. *S. invicta* exposed to Cd showed less sensitive electrophysiological and behavioral response to the three chemicals but exhibited sensitive perception to undecane. Silencing of SiOBP7 and SiOBP15 abolished the behavioral response of *S. invicta* to nonanal and

Ants easily accumulate cadmium (Cd) from the food web in terrestrial ecosystems.

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undecane, respectively, suggesting that SiOBP7 and SiOBP15 play essential roles in the chemoreception of *S. invicta*. In general, our results suggest that Cd contamination may interfere with olfactory signal transduction by altering the expression of SiOBPs, consequently evoking chemosensory dysfunction in fire ants.

Authors: Fuxiang Yang, Guoqing Zhang, Jinlong Liu, Shuanggang Duan, Lei Li, Yongyue Lu, Man-Qun Wang, Aiming Zhou
Full Source: Environmental science & technology 2022 Aug 9. doi: 10.1021/acs.est.2c03108.

ENVIRONMENTAL RESEARCH

The Path to UVCB Ecological Risk Assessment: Grappling with Substance Characterization

2022-08-12

Substances of unknown or variable composition, complex reaction products, and biological materials (UVCBs) pose a unique challenge to regulators and to product registrants, who are required to characterize their fate, exposure, hazard, and potential risks to human health and the environment. To address these challenges and ensure an efficient and fit-for-purpose process, it is proposed that the ecological risks of UVCBs be assessed following a tiered strategy. The development of this approach required exploring how substance composition ties into hazard and exposure information, and determining the extent to which a UVCB needs to be characterized to ensure a robust risk assessment. This article highlights the key aspects of this new method. It presents how a tiered substance characterization approach can be integrated into broader UVCB risk assessment schemes to encourage an examination of data needs before a full substance characterization is performed. The first tier of the characterization process, Tier 0, is a fundamental step that includes data from basic, lower resolution compositional analyses. Tier 0 assessments can be used to inform hazard and exposure for any substance of interest. The need for more sophisticated, higher tier characterization is determined by the level of uncertainty of the risk assessment. The next step of this work will integrate a tiered exposure assessment into the characterization scheme featured here, to create a more complete risk

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assessment framework. This article is protected by copyright. All rights reserved. © 2022 SETAC.

Authors: Daniel Salvito, Marc Fernandez, Sandrine E Déglin, Arey J Samuel, Delina Y Lyon, Nelson Lawson, Matthew MacLeod
Full Source: Environmental toxicology and chemistry 2022 Aug 12. doi: 10.1002/etc.5462.

Endocrine disrupting chemicals in the environment: Environmental sources, biological effects, remediation techniques, and perspective

2022-08-08

Endocrine disrupting chemicals (EDCs) have been identified as emerging contaminants, which poses a great threat to human health and ecosystem. Pesticides, polycyclic aromatic hydrocarbons, dioxins, brominated flame retardants, steroid hormones and alkylphenols are representative of this type of contaminant, which are closely related to daily life. Unfortunately, many wastewater treatment plants (WWTPs) do not treat EDCs as targets in the normal treatment process, resulting in EDCs entering the environment. Few studies have systematically reviewed the related content of EDCs in terms of occurrence, harm and remediation. For this reason, in this article, the sources and exposure routes of common EDCs are systematically described. The existence of EDCs in the environment is mainly related to human activities (Wastewater discharges and industrial activities). The common hazards of these EDCs are clarified based on available toxicological data. At the same time, the mechanism and effect of some mainstream EDCs remediation technologies (such as adsorption, advanced oxidation, membrane bioreactor, constructed wetland, etc.) are separately mentioned. Moreover, our perspectives are provided for further research of EDCs.

Authors: Yuxin Chen, Jian Yang, Bin Yao, Dan Zhi, Lin Luo, Yaoyu Zhou
Full Source: Environmental pollution (Barking, Essex : 1987) 2022 Aug 8;310:119918. doi: 10.1016/j.envpol.2022.119918.

PHARMACEUTICAL/TOXICOLOGY

Advanced Respiratory Models for Hazard Assessment of Nanomaterials-Performance of Mono-, Co- and Tricultures

2022-07-29

Advanced in vitro models are needed to support next-generation risk assessment (NGRA), moving from hazard assessment based mainly on

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animal studies to the application of new alternative methods (NAMs). Advanced models must be tested for hazard assessment of nanomaterials (NMs). The aim of this study was to perform an interlaboratory trial across two laboratories to test the robustness of and optimize a 3D lung model of human epithelial A549 cells cultivated at the air-liquid interface (ALI). Potential change in sensitivity in hazard identification when adding complexity, going from monocultures to co- and tricultures, was tested by including human endothelial cells EA.hy926 and differentiated monocytes dTHP-1. All models were exposed to NM-300K in an aerosol exposure system (VITROCELL® cloud-chamber). Cyto- and genotoxicity were measured by AlamarBlue and comet assay. Cellular uptake was investigated with transmission electron microscopy. The models were characterized by confocal microscopy and barrier function tested. We demonstrated that this advanced lung model is applicable for hazard assessment of NMs. The results point to a change in sensitivity of the model by adding complexity and to the importance of detailed protocols for robustness and reproducibility of advanced in vitro models.

Authors: Laura Maria Azzurra Camassa, Elisabeth Elje, Espen Mariussen, Eleonora Marta Longhin, Maria Dusinska, Shan Zienolddiny-Narui, Elise Rundén-Pran

Full Source: *Nanomaterials* (Basel, Switzerland) 2022 Jul 29;12(15):2609. doi: 10.3390/nano12152609.

Glyphosate differentially affects the allergic immune response across generations in mice

2022-08-11

Exposure to environmental pollutants via food, particularly during the prenatal and early postnatal periods, has been linked to adverse effects on the immune system. Among these pollutants, the widely used pesticide glyphosate has been associated with endocrine disruption, autism, and cancer. Occupational high exposure to glyphosate has also been shown to influence immune function and exacerbate allergic asthma. However, there are no studies investigating the effect of a common low-dose glyphosate exposure on the allergic immune response - neither directly nor across generations. We therefore explored the impact of oral low-dose glyphosate exposure (0.5 and 50 mg/kg body weight/day) on airway inflammation in dams (F0) and the offspring (F1 and F2 generations) using a murine multi-generational asthma model. While exposure to 50 mg/kg glyphosate induced a mild eosinophilic infiltration in the bronchoalveolar lavage and TH2 cytokine production in the dams, the F1 offspring developed a reduced immune response after maternal exposure

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to 0.5 mg/kg glyphosate. In particular, decreased lung inflammation, HDM-specific IgE levels, and asthma-relevant cytokine production were primarily observed in the female F1 offspring. However, not only the TH2 cytokines IL-13 and IL-5 but also the TH17 cytokine IL-17 and TH1 cytokine IFN- γ were reduced indicating a more general immunosuppressive function. Notably, the dampened immune response was no longer observed in the female F2 generation. Furthermore, female F1 offspring showed an increased abundance of bacteria in the gut, which have been associated with probiotic-mediated reduced allergic immune responses. Our results suggest a potential immunosuppressive effect of low-dose maternal glyphosate exposure in the F1 offspring that might be mediated by an altered microbiota composition. Further studies are needed to explore if this type of immune response modulation might also be associated with impairments in immune defense upon infectious diseases or even cancer pathology.

Authors: Lisa Buchenauer, Kristin M Junge, Sven-Bastiaan Haange, Jan C Simon, Martin von Bergen, Anna-Lena Hoh, Gabriela Aust, Ana C Zenclussen, Gabriele I Stangl, Tobias Polte

Full Source: *The Science of the total environment* 2022 Aug 11;850:157973. doi: 10.1016/j.scitotenv.2022.157973.

OCCUPATIONAL

Effect of Occupational Extremely Low-Frequency Electromagnetic Field Exposure on the Thyroid Gland of Workers: A Prospective Study

2022-08

Objective: The aim of this study was to investigate the biological effects of occupational extremely low-frequency electromagnetic field (ELF-EMF) exposure on the thyroid gland. Methods: We conducted a prospective analysis of 85 workers (exposure group) exposed to an ELF-EMF (100 μ T, 10-100 Hz) produced by the electromagnetic aircraft launch system and followed up on thyroid function indices, immunological indices, and color Doppler images for 3 years. Additionally, 116 healthy volunteers were randomly selected as controls (control group), the thyroid function of whom was compared to the exposure group. Results: No significant difference was observed in thyroid function between the exposure and control groups. During the follow-up of the exposure group, the serum free triiodothyronine (FT3) level was found to slowly decrease and free thyroxine (FT4) level slowly increase

Objective: The aim of this study was to investigate the biological effects of occupational extremely low-frequency electromagnetic field (ELF-EMF) exposure on the thyroid gland.

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with increasing exposure time. However, no significant difference was found in thyroid-stimulating hormone (TSH) over the three years, and no significant difference was observed in the FT3, FT4 and TSH levels between different exposure subgroups. Furthermore, no significant changes were observed in thyroid autoantibody levels and ultrasound images between subgroups or over time. Conclusion: Long-term exposure to ELF-EMF may promote thyroid secretion of T4 and inhibit deiodination of T4 to T3. ELF-EMF has no significant effect on thyroid immune function and morphology.

Authors: Yuan-Yuan Fang, Qian Tu, Yu-Ting Zhang, Jian Liu, Hui-Guo Liu, Zhi-Hua Zhao, Hua Wu, Tie-Jun Yin

Full Source: Current medical science 2022 Aug;42(4):817-823. doi: 10.1007/s11596-022-2610-8.

Urinary polycyclic aromatic hydrocarbon metabolites, plasma p-tau231 and mild cognitive impairment in coke oven workers

2022-08-09

Background: As a group of environmental pollutants, polycyclic aromatic hydrocarbons (PAHs) may be neurotoxic-especially in high-exposure occupational populations. However, the effect of PAHs on mild cognitive impairment (MCI) is still unclear. Objective: We aimed to investigate the relationship between PAH metabolites and MCI and to explore whether plasma p-tau231 can be used as a potential biomarker to reflect MCI in coke oven workers. Method: A total of 330 workers were recruited from a coke oven plant as the exposure group, and 234 workers were recruited from a water treatment plant as the control group. The concentrations of eleven PAH metabolites and plasma p-tau231 were determined by high-performance liquid chromatography-mass spectrometry (HPLC-MS/MS) and ELISA. Cognitive function was measured by the Montreal Cognitive Assessment (MoCA) questionnaire. A multivariate logistic regression model and multiple linear regression model were used to analyze the associations of urinary PAH metabolites with the detection rate of MCI, MoCA scores and plasma p-tau231. The dose-response relationships were evaluated using restricted cubic spline models. Results: We found 146 MCI-positive workers in coke oven plant (44.24%), and 69 MCI-positive workers in water treatment plant (29.49%). In addition, the urinary sum of PAH metabolites (-OH PAHs) was significantly associated with MCI (OR, 1.371; 95% CI:1.102-1.705). Each one-unit increase in ln-transformed -OH PAHs was associated with a 0.429 decrease in the sum of MoCA, a 0.281 reduction in the

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visuospatial/executive function and a 9.416 increase in the level of plasma P-Tau231. We found a negative association between plasma P-Tau231 and visuospatial/executive function ($\beta = -0.007$, 95% CI: -0.011, -0.003). Conclusion: Our data indicated that urinary -OH PAHs levels of workers were positively associated with MCI and the level of plasma P-Tau231.

Authors: Mengmeng Fu, Huimin Wang, Yifei Ma, Juanjuan Du, Qiao Niu, Jisheng Nie

Full Source: Chemosphere 2022 Aug 9;135911. doi: 10.1016/j.chemosphere.2022.135911

Occupational Exposure to β -d-Glucans, Mould Allergens, Endotoxins and Cultivable Fungi in Pig Farms

2022-08-12

Airborne concentrations of organic dust on animal farms are known to be very high. This dust is partly composed of microorganisms such as bacteria, fungi and their components [endotoxins, (1'3)- β -d-glucans, mould allergens, mycotoxins], recognised as being responsible for numerous health effects. Several cross-sectional studies have measured levels of airborne bacteria, fungi and endotoxins on pig farms. However, the temporal dynamics of organic dust's components throughout the year have rarely been assessed, and airborne concentrations of (1'3)- β -d-glucans and mould allergens remain poorly understood in these work environments. This longitudinal, four-season study measured cultivable fungi, endotoxins, (1'3)- β -d-glucans, *Aspergillus versicolor* (AveX), *Aspergillus fumigatus* (Asp f1) and *Alternaria* sp (Alt a1) allergens on 31 pig farms in Switzerland. Results showed that exposure to AveX occurred in all four seasons. Total mean airborne concentration of endotoxins were between 3 and 4 times higher than the Swiss recommended limit value of 1000 EU m⁻³ and mean airborne concentrations of fungi were between 30 and 50 times higher than the Swiss recommended limit value of 1000 cfu m⁻³. Finally, accumulations of faecal matter on floors, humidity and dusty pathways were associated with increased concentrations of (1'3)- β -d-glucans. In conclusion, pig farmers require better information about biological occupational risks, and measures to improve air quality should be implemented, especially in winter.

Authors: Julia G Kraemer, Markus Hilty, Anne Oppliger

Full Source: Annals of work exposures and health 2022 Aug 12;wxac055. doi: 10.1093/annweh/wxac055.

Airborne concentrations of organic dust on animal farms are known to be very high.