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CHEMICAL EFFECTS

Contamination and mortality of leaf-cutting ant workers by the quinone inside inhibitor fungicide after social interactions

2023-04-15

Leaf-cutting ants of the genera Atta and Acromyrmex (Hymenoptera: Formicidae) are the most important pests in forest and agricultural plantations and livestock. Toxic baits are the main method to manage these insects. The objective was to determine whether the behavior of allogrooming, touch, and self-grooming among Atta sexdens rubropilosa Forel, 1908 (Hymenoptera: Formicidae) workers disperse the fungicide quinone inside inhibitor and whether this product is toxic to them. This fungicide was applied, topically, in groups of workers and the social interactions between them and their mortality with and without the fungicide were evaluated. The interactions and the quinone inside inhibitor fungicide contamination increased with the number of leaf-cutting ant workers per group. Excessive touches, with subsequent allogrooming, and self-grooming among the ant workers dispersed the quinone inside the inhibitor fungicide causing 100% mortality and indicating its toxicity to this insect. The hypothesis that social interactions contaminated ant colony mates and the toxicity of the fungicide quinone inside inhibitor to workers of the leaf-cutting ant A. sexdens rubropilosa was proven.

Authors: Tamires Scudillio, Roberto da Silva Camargo, Tarcísio Marcos Macedo Mota Filho, Carlos Alberto Oliveira de Matos, José Cola Zanuncio, Julian Alberto Sabattini, Luiz Carlos Forti

Full Source: Scientific reports 2023 Apr 15;13(1):6169. doi: 10.1038/s41598-023-32796-x.

Ambiguous changes in photosynthetic parameters of Lemna minor L. after short-term exposure to naproxen and paracetamol: Can the risk be ignored?

2023-04-08

Non-steroidal anti-inflammatory drugs (NSAID) are recently monitored in the aquatic environment. Naproxen (NPX), paracetamol (PCT) and their transformation products can influence the biochemical and physiological processes at the sub-cellular and cellular levels taking part in the growth and development of plants. This study aimed to compare the effects of NPX and PCT, drugs with different physico-chemical properties, on the

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growth and photosynthetic processes in Lemna minor during a short-term (7 days) exposure. Although duckweed took up more than five times higher amount of PCT as compared to NPX (275.88 µg/g dry weight to 43.22 µg/g when treated with 10 mg/L), only NPX limited the number of new plants by 9% and 26% under 1 and 10 mg/L, respectively, and increased their dry weight (by 18% under 10 mg/L) and leaf area per plant. A considerable (by 30%) drop in the content of photosynthetic pigments under 10 mg/L treatment by both drugs did not significantly affect the efficiency of the primary processes of photosynthesis. Values of induced chlorophyll fluorescence parameters (F0, FV/FM, ΦII, and NPQ) showed just a mild stimulation by PCT and a negative effect by NPX (by up to 10%), especially on the function of photosystem II and electron transport in both intact duckweed plants and isolated chloroplasts. Lowered efficiency of Hill reaction activity (by more than 10% under 0.1 - 10 mg/L treatments) in isolated chloroplasts suspension proved the only inhibition effect of PCT to primary photosynthetic processes. In intact plants, higher treatments (0.5 - 10 mg/L) by both NPX and PCT induced an increase in RuBisCO content. The results prove that the potential effect of various drugs on plants is hard to generalise.

Authors: Štěpán Zezulka, Marie Kummerová, Ján Šmeringai, Petr Babula, Jan Tříska

Full Source: Aquatic toxicology (Amsterdam, Netherlands) 2023 Apr 8;259:106537. doi: 10.1016/j.aquatox.2023.106537.

Unraveling the toxicity of tire wear contamination in three freshwater species: From chemical mixture to nanoparticles

2023-04-11

Tire wear particle (TWP) contamination is of growing concern as recent studies show the ubiquity and toxicity of this contaminant in various environmental compartments. The multidimensional aspect of TWPs makes it difficult to assess toxicity and predict impacts on ecosystems, as it combines a complex mixture of chemicals and can release micro- and nanoparticles when suspended in water. Our work aimed to shed light on the toxicity of the different components of TWP leachate, namely, the dissolved chemicals and the nanoparticle fractions, on three freshwater model species of different trophic levels: Chlorella vulgaris, Lemna minor, and Daphnia magna. Acute toxicity was observed for all three fractions in D. magna, and an additive effect was observed between the nanoparticles and dissolved chemicals. L. minor experienced phytotoxicity from the dissolved chemicals only with a decrease up to 50% in photosynthesis efficiency parameters. C. vulgaris showed minor signs of toxicity on apical

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endpoints in response to each of the fractions. Our study highlights that nanoparticles from TWP leachate that were mostly overlooked in several previous studies are as toxic as dissolved chemicals for the filter-feeder species D. magna, and we also show the toxicity to photosynthesis in aquatic plants.
Authors: E Roubeau Dumont, X Gao, J Zheng, J Macairan, L M Hernandez, A Baesu, S Bayen, S A Robinson, S Ghoshal, N Tufenkji
Full Source: Journal of hazardous materials 2023 Apr 11;453:131402. doi: 10.1016/j.jhazmat.2023.131402.

ENVIRONMENTAL RESEARCH

A review on the pollution assessment of hazardous materials and the resultant biorefinery products in Palm oil mill effluent

2023-04-14
The voluminous nature of POME is directly associated with environmental hazards and could be turned into biorefinery products. The POME, rich in BOD, COD, and oil and grease, with few hazardous materials such as siloxanes, fatty acid methyl ester, and phenolic compounds may significantly increase the risk of violating the effluent quality standards. Recently, the application of chemical and biological risk assessment that can use electrochemical sensors and microalgae-like species has gained paramount attention towards its remediation. This review describes the existing risk assessment for POME and recommends a novel assessment approach using fish species including invasive ones as suitable for identifying the toxicants. Various physico-chemical and biological treatments such as adsorption, coagulation-flocculation, photo-oxidation, solar-assisted extraction, anaerobic digestion, integrated anaerobic-aerobic, and microalgae cultivation has been investigated. This paper offers an overview of anaerobic technologies, with particular emphasis on advanced bioreactors and their prospects for industrial-level applications. To illustrate, palmitic acid and oleic acid, the precursors of fatty acid methyl ester found in POME pave the way to produce biodiesel with 91.45%. Although there are some challenges in attaining production at an

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economic scale, this review offers some opportunities that could help in overcoming these challenges.
Authors: Anu Meena, Merrylin J, Rajesh Banu J, Shashi Bhatia, Vinod Kumar, Gregorza Piechota, Gopalakrishnan Kumar
Full Source: Environmental pollution (Barking, Essex : 1987) 2023 Apr 14;121525. doi: 10.1016/j.envpol.2023.121525.

Spatial characteristics, sources and exposure risk of polychlorinated biphenyls in dusts and soils from an urban environment in the Niger Delta of Nigeria

2023-04-13
Chlorinated organic compounds, such as polychlorinated biphenyls (PCBs), are a threat to both humans and the environment because of their toxicity, persistence, and capacity for long-range atmospheric transport. The concentrations of 28 PCB congeners including 12 dioxin-like and seven indicator PCBs were investigated in soils, and indoor and outdoor dusts from Port Harcourt city, Nigeria, in order to evaluate the characteristic distribution patterns in these media, their sources and possible risk. The PCB concentrations varied from 4.59 to 116 ng g-1 for soils, and from 1.80 to 23.0 ng g-1 and 2.73 to 57.4 ng g-1 for indoor and outdoor dusts respectively. The sequence of PCB concentrations in these matrices was soil > outdoor dust > indoor dust. The composition of PCBs in these matrices indicated the prevalence of lower chlorinated PCBs in indoor and outdoor dusts, while the higher chlorinated congeners were dominant in soils. Di-PCBs were the predominant homologues in indoor dusts, while deca-PCBs were the most prevalent homologues in outdoor dusts and soils. The TEQ values of dioxin-like PCBs in 60 % of the soils, 100 % of the indoor dust, and 30 % of the outdoor dust were above the indicative value of 4 pg TEQ g-1 established by the Canadian authority. The hazard index (HI) values for exposure of adults and children to PCBs in these media were mostly greater than one, while the total cancer risk (TCR) values exceeded the acceptable risk values of 10-6, which indicate probable non-carcinogenic and carcinogenic risks resulting from exposure to PCBs in these media. Source analysis for PCBs in these matrices shows that they originated from diverse sources.
Authors: Chinedu J Ossai, Chukwujindu M A Iwegbue, Godswill O Tesi, Chijioke Olisah, Francis E Egobueze, Godwin E Nwajei, Bice S Martincigh
Full Source: The Science of the total environment 2023 Apr 13;163513. doi: 10.1016/j.scitotenv.2023.163513.

Chlorinated organic compounds, such as polychlorinated biphenyls (PCBs), are a threat to both humans and the environment because of their toxicity, persistence, and capacity for long-range atmospheric transport.

PHARMACEUTICAL/TOXICOLOGY

Closing the knowledge gap on the composition of the asbestos bodies

2023-04-14

Asbestos bodies (AB) form in the lungs as a result of a biomineralization process initiated by the alveolar macrophages in the attempt to remove asbestos. During this process, organic and inorganic material deposit on the foreign fibers forming a Fe-rich coating. The AB start to form in months, thus quickly becoming the actual interface between asbestos and the lung tissue. Therefore, revealing their composition, and, in particular, the chemical form of Fe, which is the major component of the AB, is essential to assess their possible role in the pathogenesis of asbestos-related diseases. In this work we report the result of the first x-ray diffraction measurements performed on single AB embedded in the lung tissue samples of former asbestos plant workers. The combination with x-ray absorption spectroscopy data allowed to unambiguously reveal that Fe is present in the AB in the form of two Fe-oxy(hydroxides): ferrihydrite and goethite. The presence of goethite, which can be explained in terms of the transformation of ferrihydrite (a metastable phase) due to the acidic conditions induced by the alveolar macrophages in their attempt to phagocytose the fibers, has toxicological implications that are discussed in the paper.

Authors: F Bardelli, C Giacobbe, P Ballirano, V Borelli, F Di Benedetto, G Montegrossi, D Bellis, A Pacella

Full Source: Environmental geochemistry and health 2023 Apr 14. doi: 10.1007/s10653-023-01557-0.

Asbestos bodies (AB) form in the lungs as a result of a biomineral-ization process initiated by the alveolar macro-phages in the attempt to remove asbestos.

Particulate air pollution exaggerates diet-induced insulin resistance through NLRP3 inflammasome in mice

2023-04-14

Air particulate matter 2.5 (PM2.5) has been demonstrated to exaggerate insulin resistance in both human and animal studies. However, the exact molecular mechanisms remain elusive. This study sought to assess the role of NLRP3 inflammasome in PM2.5 exposure-induced insulin resistance and explore the underlying mechanisms. Wild-type (WT), Nlrp3-/-, Tlr4Lps-d, or Nrf2-/- mice, on a normal diet or high-fat diet (HFD), were exposed to PM2.5 or filtered air (FA) in a whole-body exposure facility. Priming (first signal) and assembly (second signal) of NLRP3 inflammasome activation were assessed by measuring the transcription of Nlrp3/Il-1β and detecting

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the activity of caspase-1 and secretion of IL-1β. We found PM2.5 exposure exaggerated insulin resistance and increased IL-1β production in the HFD-fed WT mice, but not Nlrp3-/- mice. Gene expressions of Nlrp3 and Il-1β in the lungs and peritoneal macrophages were upregulated in WT mice exposed to PM2.5. When stimulated with LPS (first signal) or monosodium urate (second signal), PM2.5 exposure was able to enhance the activity of caspase-1 and IL-1β secretion, suggesting that PM2.5 may serve as a stimulus of either the first or second signal for NLRP3 inflammasome activation. Effects of PM2.5 on caspase-1 activation and IL-1β secretion were partially blocked in Tlr4Lps-d mice. Reactive oxygen species (ROS), co-localization of NLRP3 and mitochondria, and secondary lysosomes in macrophages were increased after PM2.5 exposure, while deficiency of antioxidant gene Nrf2 in mice significantly enhanced PM2.5-induced secretion of IL-1β. Imaging flow cytometry and transmission electron microscopy demonstrated an engulfment of PM2.5 particles by macrophages, while suppression of phagocytosis by cytochalasin D abolished PM2.5-induced transcription of Nlrp3/Il-1β. Our results demonstrated a critical role of NLRP3 inflammasome in PM2.5 exaggerated insulin resistance, and multiple pathways in the first and second signals of NLRP3 inflammasome activation may be involved.

Authors: Jixin Zhong, Gang Zhao, Sabrina Edwards, Joanne Tran, Sanjay Rajagopalan, Xiaoquan Rao

Full Source: Environmental pollution (Barking, Essex : 1987) 2023 Apr 14;121603. doi: 10.1016/j.envpol.2023.121603.

The presence of pharmaceuticals in the environment is a matter of great concern.

Biochemical and physiological changes in Zea mays L. after exposure to the environmental pharmaceutical pollutant carbamazepine

2023-04-12

The presence of pharmaceuticals in the environment is a matter of great concern. They are consistently found in the environment, raising concerns regarding human exposure through dietary intake. In this study, we observed the effect of the application of carbamazepine at 0.1, 1, 10, and 1000 µg per kg of soil contamination levels to assess stress metabolism in Zea mays L. cv. Ronaldinio at the 4th leaf, tasselling, and dent phenological stages. The transfer of carbamazepine to the aboveground and root biomass was assessed, and uptake increased dose-dependently. No direct effect on biomass production was observed, but multiple physiological and chemical changes were observed. Major effects were consistently observed at the 4th leaf phenological stage for all contamination levels, including reduced photosynthetic rate, reduced maximal and

potential activity of photosystem II, decreased water potential, decreased carbohydrates (glucose and fructose) and γ-aminobutyric acid in roots, and increased maleic acid and phenylpropanoids (chlorogenic acid and its isomer, 5-O-caffeoylquinic acid) in aboveground biomass. A reduction in net photosynthesis was observed for the older phenological stages, whereas no other relevant and consistent physiological and metabolic changes related to contamination exposure were detected. Our results indicate that Z. mays can overcome the environmental stress caused by the accumulation of carbamazepine with notable metabolic changes at the early phenological stage; however, older plants adapted and only exhibited minor effects in the presence of the contaminant. The potential implications for agricultural practice could be associated with the plant's response to simultaneous stresses due to metabolite changes associated with oxidative stress.

Authors: Anna Mascellani, Filip Mercl, Sebnem Kurhan, Lorenzo Pierdoná, Jiri Kudrna, Veronika Zemanová, František Hnilička, Pavel Kloucek, Pavel Tlustos, Jaroslav Havlik

Full Source: Chemosphere 2023 Apr 12;138689. doi: 10.1016/j.chemosphere.2023.138689.

OCCUPATIONAL

Evaluation of perinatal exposure effects to the endocrine disrupting herbicide glyphosate and its mixture with 2,4-D and dicamba on liver redox status in Wistar rats

2023-04-14

Wide-scale emergence of glyphosate-resistant weeds has led to an increase in the simultaneous application of herbicide mixtures exacerbated by the introduction of crops tolerant to glyphosate plus dicamba or glyphosate plus 2,4-D. This raises serious concerns regarding the environmental and health risks resulting from increased exposure to a mixture of herbicide active ingredients. We evaluated hepatotoxic effects following perinatal exposure to the endocrine disrupting herbicide glyphosate alone or in combination with 2,4-D and dicamba from gestational day-6 until adulthood in Wistar rats. Animals were administered with glyphosate at the European Union (EU) acceptable daily intake (ADI; 0.5 mg/kg bw/day) and no-observed-adverse-effect level (NOAEL; 50 mg/kg bw/day). A mixture of glyphosate with 2,4-D (0.3 mg/kg bw/day) and dicamba (0.02 mg/kg bw/day) with each at their EU ADI was evaluated. Redox status was determined by measuring levels of

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reduced glutathione, decomposition rate of H2O2, glutathione reductase, glutathione peroxidase, total antioxidant capacity, thiobarbituric reactive substances, and protein carbonyls. Gene expression analysis of Nr1d1, Nr1d2, Clec2g, Ier3, and Gadd45g associated with oxidative damage to DNA, was also performed. Analysis of liver samples showed that exposure to the mixture of the three herbicides induced a marked increase in the concentration of glutathione and malondialdehyde indicative of a disturbance in redox balance. Nevertheless, the effect of increased lipid peroxidation was not discernible following a 3-month recuperation period where animals were withdrawn from pesticide exposure post-weaning. Interestingly, toxic effects caused by prenatal exposure to the glyphosate NOAEL were present after the same 3-month recovery period. No statistically significant changes in the expression of genes linked with genotoxicity were observed. Our findings reinforce the importance of assessing the combined effects of chemical pollutants at doses that are asserted by regulatory agencies to be safe individually.

Authors: Paraskevi-Maria Nechalioti, Thomas Karampatzakis, Robin Mesnage, Michael N Antoniou, Mariam Ibragim, Aristidis Tsatsakis, Anca Oana Docea, Charitini Nepka, Demetrios Kouretas

Full Source: Environmental research 2023 Apr 14;115906. doi: 10.1016/j.envres.2023.115906.

A physiologically-based kinetic (PBK) model for work-related diisocyanate exposure: Relevance for the design and reporting of biomonitoring studies

2023-04-06

Diisocyanates are highly reactive substances and known causes of occupational asthma. Exposure occurs mainly in the occupational setting and can be assessed through biomonitoring which accounts for inhalation and dermal exposure and potential effects of protective equipment. However the interpretation of biomonitoring data can be challenging for chemicals with complex kinetic behavior and multiple exposure routes, as is the case for diisocyanates. To better understand the relation between external exposure and urinary concentrations of metabolites of diisocyanates, we developed a physiologically based kinetic (PBK) model for methylene bisphenyl isocyanate (MDI) and toluene di-isocyanate (TDI). The PBK model covers both inhalation and dermal exposure, and can be used to estimate biomarker levels after either single or chronic exposures. Key parameters such as absorption and elimination rates of diisocyanates were based on results from human controlled exposure studies. A global sensitivity analysis was performed on model predictions after assigning

Diisocyanates are highly reactive substances and known causes of occupational asthma.

distributions reflecting a mixture of parameter uncertainty and population variability. Although model-based predictions of urinary concentrations of the degradation products of MDI and TDI for longer-term exposure scenarios compared relatively well to empirical results for a limited set of biomonitoring studies in the peer-reviewed literature, validation of model predictions was difficult because of the many uncertainties regarding the precise exposure scenarios that were used. Sensitivity analyses indicated that parameters with a relatively large impact on model estimates included the fraction of diisocyanates absorbed and the binding rate of diisocyanates to albumin relative to other macro molecules. We additionally investigated the effects of timing of exposure and intermittent urination, and found that both had a considerable impact on estimated urinary biomarker levels. This suggests that these factors should be taken into account when interpreting biomonitoring data and included in the standard reporting of isocyanate biomonitoring studies.

Authors: B Scholten, J Westerhout, A Pronk, R Stierum, J Vlaanderen, R Vermeulen, K Jones, T Santonen, L Portengen

Full Source: Environment international 2023 Apr 6;174:107917. doi: 10.1016/j.envint.2023.107917.