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CHEMICAL EFFECTS

The use of calcium carbide in food and fruit ripening: Potential mechanisms of toxicity to humans and future prospects

2022-01-29

The global increase in the demand for ripe fruits has induced unhealthy use of toxic chemicals in fruit ripening. One of such chemicals in common use is calcium carbide (CaC₂). Due to its nature, commercial CaC₂ is consistently found to contain impurities such as Arsenic and other toxic and carcinogenic chemicals. Few studies have only reported acute associative effects of CaC₂, whereas there is only sparse evidence of its chronic and long-term impact. This article reviewed all the information on the nature of commercial CaC₂ used for food processing. Meanwhile, all reports on the acute effects of CaC₂, such as skin burns, skin irritations and inflammation, were summarized. Despite reported acute cases, an increase in commercial CaC₂ for fruit ripening has been reported in recent times, especially in developing countries, as many vendors may consider the toxic effects/risks as negligible. Therefore, this study highlighted the paucity in research studies on the chronic impact of commercial CaC₂ while proposing possible mechanisms for CaC₂ induction of cancer, cardiovascular dysfunction, diabetic mellitus and others. Furthermore, suggestions on further studies to unravel the chronic impacts of CaC₂ on health and recommendations for viable alternatives of fruit ripening with minimal or zero toxicity were proffered. Finally, other suggestions such as improving CaC₂ detection technologies and innovative grassroots educational programs will strengthen national and international agencies to enforce restrictions on the illicit use of the toxicant for fruit ripening.

Authors: Emmanuel Sunday Okeke, Innocent Uzochukwu Okagu, Charles Obinwanne Okoye, Timothy Prince Chidike Ezeorba

Full Source: Toxicology 2022 Jan 29;468:153112. doi: 10.1016/j.tox.2022.153112.

Occurrence, impact, toxicity, and degradation methods of microplastics in environment-a review

2022-01-28

Microplastic defines as a tiny plastic particle that has a size of less than 5 mm and is ubiquitous in the environment. Due to the tiny size, this microplastic adversely affected the environment, notably aquatic life via ingestion, choking, and entanglement. This microplastic is arduous

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to degrade as it takes a thousand years due to the properties of plastic itself and consequently remains in nature. In dealing with microplastic issues, this paper reflects the occurrence, impact, toxicity, and degradation methods of microplastics in the environment including physical, chemical, and biological treatments. Here, the physical treatment methods include incineration treatment, ultraviolet (UV), and photocatalytic. The incineration process contributes to environmental pollution due to the release of toxic gases into the atmosphere. In addition, chemical treatments for plastic waste are the degradation process involving chemical additives such as ethylene glycol (EG), nano-magnesium oxide (MgO), diethylene glycol (DEG), and calcium or zinc (Ca/Zn) stearate as a catalyst. These treatments depend on the chemicals that can affect human health and the ecosystem. The biodegradation treatment using bacterial and fungal species can consume the microplastic without disrupting the surrounding environment and biota. It includes recent findings on the biodegradation of microplastic under aerobic and anaerobic conditions. Thus, biodegradation can be considered the best option to degrade microplastic as green and sustainable technology.

Authors: Norhafezah Kasmuri, Nur Aliah Ahmad Tarmizi, Amin Mojiri
Full Source: Environmental science and pollution research international 2022 Jan 28. doi: 10.1007/s11356-021-18268-7.

Suspected-screening assessment of the occurrence of organic compounds in sewage sludge

2022-02-02

The profiling of emerging organic pollutants present in sludge and generated during wastewater treatment is much more limited than in water. This is mainly due to the difficulty of sludge analysis because of its high content of organic matter and interfering compounds. In this study, a generic extraction method using a mixture of buffered water (pH 4.1) and solid phase extraction (SPE) clean-up was applied to samples of sludge obtained in different treatment plants. This extraction was followed by determination of the contaminants by ultra-high performance liquid chromatography coupled to high resolution mass spectrometry (UHPLC-HRMS), using suspected screening to detect the most relevant organic compounds that access the environment through sludge application. This screening (including >3000 substances, such as, pharmaceuticals, pesticides, metabolites and industrial chemicals) tentatively identified 122 compound and assigned most probable structure to 39. The set of compounds assigned to a probable structure was increased in 14 compounds by searching in a free database of metabolites. Fifteen

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compounds were unequivocally confirmed against the analytical standard. Pharmaceuticals and personal care products (PPCPs), with 31 substances identified and 8 confirmed were the main group of compounds. Compounds frequently detected in all sludge samples include nucleotides such as adenosine triphosphate, amino acids such as phenylalanine, or peptides such as leu-phe. Altogether, the results of this work highlight the interest of HRMS to draw the profile of organic compounds in complex matrices.

Authors: Alejandro Cuñat, Rodrigo Álvarez-Ruiz, Maria M Morales Suarez-Varela, Yolanda Pico

Full Source: Journal of environmental management 2022 Feb 2;308:114587. doi: 10.1016/j.jenvman.2022.114587.

Occupational health hazards and wide spectrum of genetic damage by the organic solvent fumes at the workplace: A critical appraisal

2022-01-31

Long-term exposure to organic solvents is known to affect human health posing serious occupational hazards. Organic solvents are genotoxic, and they can cause genetic changes in the exposed employees' somatic or germ cells. Chemicals such as benzene, toluene, and gasoline induce an excessive amount of genotoxicity results either in genetic polymorphism or culminates in deleterious mutations when concentration crosses the threshold limits. The impact of genotoxicity is directly related to the time of exposure, types, and quantum of solvent. Genotoxicity affects almost all the physiological systems, but the most vulnerable ones are the nervous system, reproductive system, and blood circulatory system. Based on the available literature report, we propose to evaluate the outcomes of such chemicals on the exposed humans at the workplace. Attempts would be made to ascertain if the long-term exposure makes a person resistant to such chemicals. This may seem to be a far-fetched idea but has not been studied. The health prospect of this study is envisaged to complement the already existing data facilitating a deeper understanding of the genotoxicity across the population. This would also demonstrate if it correlates with the demographic profile of the population and contributes to comorbidity and epidemiology.

Authors: Neha Verma, Soumya Pandit, Piyush Kumar Gupta, Sanjay Kumar, Anil Kumar, Shiv Kumar Giri, Gulab Yadav, Kanu Priya

Full Source: Environmental science and pollution research international 2022 Jan 31. doi: 10.1007/s11356-022-18889-6.

Long-term exposure to organic solvents is known to affect human health posing serious occupational hazards.

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ENVIRONMENTAL RESEARCH

Ambient air pollution exposure and increasing depressive symptoms in older women: The mediating role of the prefrontal cortex and insula

2022-02-02

Exposures to fine particulate matter (PM_{2.5}) and nitrogen dioxide (NO₂) have been associated with the emergence of depressive symptoms in older adulthood, although most studies used cross-sectional outcome measures. Elucidating the brain structures mediating the adverse effects can strengthen the causal role between air pollution and increasing depressive symptoms. We evaluated whether smaller volumes of brain structures implicated in late-life depression mediate associations between ambient air pollution exposure and changes in depressive symptoms. This prospective study included 764 community-dwelling older women (aged 81.6 ± 3.6 in 2008-2010) from the Women's Health Initiative Memory Study (WHIMS) Magnetic Resonance Imaging study (WHIMS-MRI; 2005-06) and WHIMS-Epidemiology of Cognitive Health Outcomes (WHIMS-ECHO; 2008-16). Three-year average annual mean concentrations (scaled by interquartile range [IQR]) of ambient PM_{2.5} (in $\mu\text{g}/\text{m}^3$; IQR = $3.14 \mu\text{g}/\text{m}^3$) and NO₂ (in ppb; IQR = 7.80 ppb) before WHIMS-MRI were estimated at participants' addresses via spatiotemporal models. Mediators included structural brain MRI-derived grey matter volumes of the prefrontal cortex and structures of the limbic-cortical-striatal-pallidal-thalamic circuit. Depressive symptoms were assessed annually by the 15-item Geriatric Depression Scale. Structural equation models were constructed to estimate associations between exposure, structural brain variables, and depressive symptoms. Increased exposures (by each IQR) were associated with greater annual increases in depressive symptoms ($\beta_{\text{PM}_{2.5}} = 0.022$; 95% Confidence Interval (CI) = 0.003, 0.042; $\beta_{\text{NO}_2} = 0.019$; 95% CI = 0.001, 0.037). The smaller volume of prefrontal cortex associated with exposures partially mediated the associations of increased depressive symptoms with NO₂ (8%) and PM_{2.5} (13%), and smaller insula volume associated with NO₂ contributed modestly (13%) to the subsequent increase in depressive symptoms. We demonstrate the first evidence that the smaller volumes of the prefrontal cortex and insula may mediate the subsequent increases in depressive symptoms associated with late-life exposures to NO₂ and PM_{2.5}.

Authors: Andrew J Petkus, Susan M Resnick, Xinhui Wang, Daniel P Beavers, Mark A Espeland, Margaret Gatz, Tara Gruenewald, Joshua Millstein,

Exposures to fine particulate matter (PM_{2.5}) and nitrogen dioxide (NO₂) have been associated with the emergence of depressive symptoms in older adulthood, although most studies used cross-sectional outcome measures.

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Helena C Chui, Joel D Kaufman, JoAnn E Manson, Gregory A Wellenius, Eric A Whitsel, Keith Widaman, Diana Younan, Jiu-Chiuan Chen
Full Source: The Science of the total environment 2022 Feb 2;153642. doi: 10.1016/j.scitotenv.2022.153642.

Exploring the adsorption behavior of benzotriazoles and benzothiazoles on polyvinyl chloride microplastics in the water environment

2022-01-28

As a kind of emerging pollutant, microplastics (MPs) play an important role as a carrier for pollutant migration in the water environment. Carried by the MPs, benzotriazoles, and benzothiazoles (collectively referred to as BTs) are ubiquitous water contaminants. In this paper, the adsorption behavior of BTs on polyvinyl chloride (PVC) MPs was first studied systematically to explain the adsorptive mechanisms and the consequential pollution caused by the absorption-desorption process. The studies on kinetics, isotherms, and thermodynamics revealed that the adsorption of BTs on PVC MPs was a multi-rate, heterogeneous multi-layer, and exothermic process, which was affected by external diffusion, intra-particle diffusion, and dynamic equilibrium. The factors including pH, salinity, and particle size also influenced the adsorption process. In the multi-solute system, competitive adsorption would occur between different BTs. The desorption of BTs from PVC MPs was positively associated with the increase of adsorption amount. Based on the results, the adsorption mechanisms of PVC MPs were clarified, involving hydrophobic interaction, electrostatic force, and non-covalent bonds. It was demonstrated that BTs in the water environment could most probably be accumulated and migrated through MPs, and eventually carried into organisms, posing an increased risk to the ecological environment.

Authors: Yanbin Yu, Huichen Li, Jinfeng Chen, Fangjie Wang, Xiaoning Chen, Bowen Huang, Yu He, Zongwei Cai

Full Source: The Science of the total environment 2022 Jan 28;153471. doi: 10.1016/j.scitotenv.2022.153471.

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OCCUPATIONAL

The effectiveness of educational interventions aimed at agricultural workers' knowledge, behaviour, and risk perception for reducing the risk of pesticide exposure: a systematic review and meta-analysis

2022-02-01

Aim: The aim of this study was to determine the effectiveness of educational interventions aimed at agricultural workers' knowledge, behaviour, and risk perception for reducing the risk of pesticide exposure.
Method: All studies published in the English language between the years 2000 and 2020 were screened on relevant databases. The study protocol was registered on PROSPERO. Randomised controlled studies (RCTs) and quasi-experimental studies meeting the inclusion and exclusion criteria according to the PICOS criteria were included. In line with the PRISMA flow diagram, 38 studies were included in the systematic review and meta-analysis. Risk of bias was assessed with the Cochrane risk-of-bias assessment tool. A random-effects model was applied and Hedge's g was used to calculate effect size.
Findings: Five of the included studies are RCTs, two are cluster RCTs, 17 are quasi-experimental studies with experimental and control groups, and 14 have single-group pretest-posttest study designs. Educational interventions had a large effect on knowledge level (Hedge's $g = 0.890$), a medium effect on behaviour level (Hedge's $g = 0.707$), and a small effect on risk perception (Hedge's $g = 0.377$). No publication bias was detected. The largest effect of educational interventions on both knowledge and behaviour levels belonged to studies grounded on a theoretical basis and carried out between the years 2011 and 2020.
Conclusion: It was determined that educational interventions are an appropriate method for reducing the pesticide exposure risks of agricultural workers. To increase the effectiveness of these interventions, it is recommended that consideration is given to a theoretical basis, the use of multiple education components, and evidence-based practices.

Authors: Dilek Ayaz, Selma Öncel, Engin Karadağ

Full Source: International archives of occupational and environmental health 2022 Feb 1. doi: 10.1007/s00420-022-01838-8.

Aim: The aim of this study was to determine the effectiveness of educational interventions aimed at agricultural workers' knowledge, behaviour, and risk perception for reducing the risk of pesticide exposure.

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Characterization of ecotoxicological risks from unintentional mixture exposures calculated from European freshwater monitoring data: Forwarding prospective chemical risk management

2022-01-25

Current regulatory chemical safety assessments do not acknowledge that ambient exposures are to multiple chemicals at the same time. As a result, potentially harmful exposures to unintentional mixtures may occur, leading to potential insufficient protection of the environment. The present study describes cumulative environmental risk assessment results for European fresh water ecosystems, based on the NORMAN chemical surface water monitoring database (1998-2016). It aims to characterize the magnitude of the mixture problem and the relative contribution of chemicals to the mixture risk, and evaluates how cumulative risks reduce when the acceptable risk per single chemical is fractionally lowered. Available monitoring data were curated and aggregated to 26,631 place-time combinations with at least two chemicals, of which 376 place-time combinations had at least 25 chemicals identified above the Limit of Detection. Various risk metrics were based on measured environmental concentrations (MECs). Mixture risk characterization ratio's (Σ RCRs) ≥ 1 were found for 39% of the place-time combinations, with few chemicals dominating the Σ RCR. Analyses of mixture toxic pressures, expressed as multi-substance Potentially Affected Fractions of species based on No Observed Effect Concentrations (msPAF-NOEC), showed similar outcomes. Small fractional reductions of the ambient chemical concentrations give a steep increase of the percentage of sufficiently protected water bodies (i.e. Σ RCR < 1 and msPAF-NOEC $< 5\%$). Scientific and regulatory aspects of these results are discussed, especially with reference to the representativeness of the monitoring data for characterizing ambient mixtures, the robustness of the findings, and the possible regulatory implementation of the concept of a Mixture Allocation Factor (MAF) for prospective chemicals risk management. Although the monitoring data do not represent the full spectrum of ambient mixture exposures in Europe, results show the need for adapting policies to reach European Union goals for a toxic-free environment and underpin the utility and possible magnitude of a MAF.

Authors: Emiel Rorije, Pim N H Wassenaar, Jaap Slootweg, Lonneke van Leeuwen, Fleur A van Broekhuizen, Leo Posthuma

Full Source: The Science of the total environment 2022 Jan 25;153385. doi: 10.1016/j.scitotenv.2022.153385.

Current regulatory chemical safety assessments do not acknowledge that ambient exposures are to multiple chemicals at the same time.

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Exposure and work-related factors in subjects with hand eczema: data from a cross-sectional questionnaire within the Lifelines Cohort study

2022-02-04

Background: Hand eczema (HE) is the most frequent occupational skin disease. However, studies on non-occupational wet exposure, occupations not considered as high-risk, and socioeconomic factors are scarce. **Objectives:** To investigate the association between HE and occupational and non-occupational wet exposure and work-related factors in the Dutch general population. **Methods:** Within the Lifelines Cohort Study, participants with HE were identified by a digital add-on questionnaire, including questions regarding exposure. Data on work-related and socioeconomic factors were collected from baseline. **Results:** Overall, 57 046 participants (42.0%) were included. Occupational and non-occupational wet exposure were positive associated with HE in the past year (Odds Ratios (OR) 1.35 95% confidence interval (CI) [1.22-1.49] and OR 1.34 95% CI [1.17-1.53], respectively). Positive associations for high-risk occupations (OR 1.20 95% CI [1.06-1.36] for personal care workers in health services and OR 1.25 95% CI [1.06-1.48] for nursing and midwifery professionals), occupations not considered as high-risk (OR 1.19 95% CI [1.03-1.39] for legal, social and religious associate professionals) and higher levels of education were found (OR 1.17 95% CI [1.04-1.32] and OR 1.18 95% CI [1.04-1.34] for middle and high level, respectively). **Conclusion:** Preventive strategies for HE should focus on avoidance of all exposure to wet, regardless of origin. In addition, job tasks instead of job title should be taken into account. As previous results on the association between HE and socioeconomic factors differ, future research should focus on a uniform definition. This article is protected by copyright. All rights reserved.

Authors: Marjolein J Brands, Laura Loman, Marie L A Schuttelaar

Full Source: Contact dermatitis 2022 Feb 4. doi: 10.1111/cod.14066.

Background: Hand eczema (HE) is the most frequent occupational skin disease.

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PHARAMACEUTICAL/TOXICOLOGY

Exposure pathways and bioaccumulation of per- and polyfluoroalkyl substances in freshwater aquatic ecosystems: Key considerations

2022-01-29

Due to the bioaccumulative behavior, toxicity, and recalcitrance to degradation, per- and polyfluoroalkyl substances (PFAS) are a focus for many researchers investigating freshwater aquatic ecosystems. PFAS are a diverse set of chemicals that accumulate and transport quite differently in the environment depending on the length of their fluoroalkyl chains and their functional groups. This diversity in PFAS chemical characteristics combined with varying environmental factors also impact the bioaccumulation of these compounds in different organisms. In this review, we evaluate environmental factors (such as organic carbon, proteins, lipids, and dissolved cations) as well as PFAS characteristics (head group, chain-length, and concentration) that contribute to the significant variation seen in the literature of bioaccumulation metrics reported for organisms in aquatic ecosystems. Of the factors evaluated, it was found that PFAS concentration, dissolved organic matter, sediment organic matter, and biotransformation of precursor PFAS tended to significantly impact reported bioaccumulation metrics the most. Based on this review, it is highly suggested that future studies provide sufficient details of important environmental factors, specific organism traits/ behavior, and PFAS concentrations/compounds when reporting on bioaccumulation metrics to further fill data gaps and improve our understanding of PFAS in aquatic ecosystems.

Authors: Asa J Lewis, Xiaoyan Yun, Daniel E Spooner, Marie J Kurz, Erica R McKenzie, Christopher M Sales

Full Source: The Science of the total environment 2022 Jan 29;822:153561. doi: 10.1016/j.scitotenv.2022.153561.

Due to the bioaccumulative behavior, toxicity, and recalcitrance to degradation, per- and polyfluoroalkyl substances (PFAS) are a focus for many researchers investigating freshwater aquatic ecosystems.