CHEMWATCH

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CHEMICAL EFFECTS

Counteracting Environmental Chemicals with Coenzyme Q10: An Educational Primer for Use with "Antioxidant CoQ10 Restores Fertility by Rescuing Bisphenol A-Induced Oxidative DNA Damage in the Caenorhabditis elegans Germline"

2020-12

Environmental toxicants are chemicals that negatively affect human health. Although there are numerous ways to limit exposure, the ubiquitous nature of certain environmental toxicants makes it impossible to avoid them entirely. Consequently, scientists are continuously working toward developing strategies for combating their harmful effects. Using the nematode Caenorhabditis elegans, a model with many genetic and physiological similarities to humans, researchers in the Colaiácovo laboratory have identified several molecular mechanisms by which the toxic agent bisphenol A (BPA) interferes with reproduction. Here, we address their recent discovery that a widely available compound, Coenzyme Q10 (CoQ10), can rescue BPA-induced damage. This work is significant in that it poses a low-cost method for improving reproductive success in humans. The goal of this primer is to assist educators and students with navigating the paper entitled "Antioxidant CoQ10 Restores Fertility by Rescuing Bisphenol A-Induced Oxidative DNA Damage in the Caenorhabditis elegans Germline." It is ideally suited for integration into an upper-level undergraduate course such as Genetics, Cell and Molecular Biology, Developmental Biology, or Toxicology. The primer provides background information on the history of BPA, the utility of the C. elegans germ line as a model for studying reproductive toxicity, and research methods including assessment of programmed cell death, fluorescent microscopy applications, and assays to quantify gene expression. Questions for deeper exploration in-class or online are provided.Related article in GENETICS: Hornos Carneiro MF, Shin N, Karthikraj R, Barbosa F Jr, Kannan K, Colaiácovo MP. Antioxidant CoQ10 restores fertility by rescuing bisphenol A-induced oxidative DNA damage in the Caenorhabditis elegans Germline. Genetics 214:381-395.

Authors: Beatrix R Bradford, Nicole E Briand, Nina Fassnacht, Esabelle D Gervasio, Aidan M Nowakowski, Theresa C FitzGibbon, Stephanie Maurina, Alexis V Benjamin, MaryEllen Kelly, Paula M Checchi

Full Source: Genetics 2020 Dec;216(4):879-890. doi: 10.1534/genetics.120.303577.

Environmental toxicants are chemicals that negatively affect human health.

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Influence of chemical charge on the fate of organic chemicals in sediment particle size fractions

2020-11-24

In order to investigate the influence of differently sized particle fractions on the fate of ionic chemicals in water-sediment systems, we performed simulation studies following OECD guideline 308. We used 14C-labelled anionic (4-n-dodecylbenzenesulfonic acid sodium salt, '14C-DS-'), cationic (4-n-dodecylbenzyltrimethyl ammonium chloride, '14C-DA+') and non-ionic (4-n-dodecylphenol, '14C-DP') organic chemicals. The sediment was subjected to particle size fractionation. For each particle fraction and test compound, water-sediment systems were prepared and incubated for 14 days. Across all particle fractions, higher amounts of applied radioactivity (AR) of 14C-DS- (in sand 60.1%, in silt 45.1%, in clay 57.0%) and of 14C-DP (sand: 31.8%, silt: 24.4%, clay: 29.2%) were mineralised compared to 14C-DA+ (sand: 5.1% AR, silt: 3.5% AR, clay: 2.4% AR). The highest bioavailability was observed for 14C-DS- followed by 14C-DP and 14C-DA+ across all particle fractions. Formation of non-extractable residues (NER) of 14C-DS- did not substantially differ between the particle fractions, whereas NER formation of 14C-DA+ was higher in the clay fraction (24.3% AR) than in silt (15.9% AR) and sand (8.4% AR). The same trend was observed for 14C-DP. We showed that differently sized particle fractions have an influence on the fate of ionic chemicals in water-sediment systems and conclude that this should be considered when simulation studies in soils and sediments with different textural compositions are performed. Since a positive charge of organic chemicals tends to form higher portions of NER in the clay fraction of sediments, these NER should be further investigated in terms of their nature and types of binding.

Authors: Hannah Holzmann, Andrea Simeoni, Andreas Schäffer

Full Source: Chemosphere 2020 Nov 24;129105. doi: 10.1016/j.chemosphere.2020.129105.

In order to investigate the influence of differently sized particle fractions on the fate of ionic chemicals in water-sediment systems, we performed simulation studies following OECD guideline 308.

Overview of intentionally used food contact chemicals and their hazards

2020-11-25

Food contact materials (FCMs) are used to make food contact articles (FCAs) that come into contact with food and beverages during, e.g., processing, storing, packaging, or consumption. FCMs/FCAs can cause chemical contamination of food when migration of their chemical constituents (known as food contact chemicals, FCCs) occurs. Some FCCs are known to be hazardous. However, the total extent of exposure

to FCCs, as well as their health and environmental effects, remain unknown, because information on chemical structures, use patterns, migration potential, and health effects of FCCs is often absent or scattered across multiple sources. Therefore, we initiated a research project to systematically collect, analyze, and publicly share information on FCCs. As a first step, we compiled a database of intentionally added food contact chemicals (FCCdb), presented here. The FCCdb lists 12'285 substances that could possibly be used worldwide to make FCMs/FCAs, identified based on 67 FCC lists from publicly available sources, such as regulatory lists and industry inventories. We further explored FCCdb chemicals' hazards using several authoritative sources of hazard information, including (i) classifications for health and environmental hazards under the globally harmonized system for classification and labeling of chemicals (GHS), (ii) the identification of chemicals of concern due to endocrine disruption or persistence related hazards, and (iii) the inclusion on selected EU- or US-relevant regulatory lists of hazardous chemicals. This analysis prioritized 608 hazardous FCCs for further assessment and substitution in FCMs/FCAs. Evaluation based on non-authoritative, predictive hazard data (e.g., by in silico modeling or literature analysis) highlighted an additional 1411 FCCdb substances that could thus present similar levels of concern, but have not been officially classified so far. Lastly, for over a quarter of all FCCdb chemicals no hazard information could be found in the sources consulted, revealing a significant data gap and research need.

Authors: Ksenia J Groh, Birgit Geueke, Olwenn Martin, Maricel Maffini, Jane Muncke

Full Source: Environment international 2020 Nov 25;106225. doi: 10.1016/j.envint.2020.106225.

ENVIRONMENTAL RESEARCH

New approach to removal of hazardous Bypass Cement Dust (BCD) from the environment: 20Na2O-20BaCl 2-(60-x)B 2 O 3-(x)BCD glass system and Optical, mechanical, structural and nuclear radiation shielding competences

2021-02-05

In the present work, aiming to collaborate in the removal of Bypass Cement Dust (BCD) from the environment, we studied a system consisting of three glasses prepared from analytical reagent grade chemicals with the following composition: 20Na2O-20BaCl2-(60-x)B2O3-xBCD, where (x = 0, 10, and 20 %). BCD is an important contributor of many respiratory

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human health issues. In this work we investigate their optical, physical and gamma-ray shielding properties. The experimental results of mass attenuation coefficients are contrasted with the FLUKA Monte Carlo code and the XCOM database at 0.081, 0.356, 0.662, 1.173, and 1.332 MeV photon energies. Additionally, the mechanical, structural, and optical properties of these glasses were measured. A rising peak with an increase of BCD concentration in the region from 450 cm-1 to 480 cm-1 was observed. The results show that shielding properties such as the mass attenuation coefficient (μm), the effective atomic number (Zeff), and the effective electron density (Nel) increase as BCD fraction increases. The half value layer (HVL), the tenth value layer (TVL), and the mean free path (MFP) decrease as the BCD content increases. It is noticed that 20Na2O-20BaCl2-(60-x)B2O3-xBCD, where (x = 0, 10, and 20 %), has the highest optical conductivity value at x = 20%. It was found that the gradual addition of BCD content increases the hardness of the studied glasses.

Authors: A I Elazaka, Hesham M H Zakaly, Shams A M Issa, M Rashad, H O Tekin, H A Saudi, V H Gillette, T T Erguzel, A G Mostafa

Full Source: Journal of hazardous materials 2021 Feb 5;403:123738. doi: 10.1016/j.jhazmat.2020.123738.

Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review

2020-12-02

(1) Background: There is increasing awareness that the quality of the indoor environment affects our health and well-being. Indoor air quality (IAQ) in particular has an impact on multiple health outcomes, including respiratory and cardiovascular illness, allergic symptoms, cancers, and premature mortality. (2) Methods: We carried out a global systematic literature review on indoor exposure to selected air pollutants associated with adverse health effects, and related household characteristics, seasonal influences and occupancy patterns. We screened records from six bibliographic databases: ABI/INFORM, Environment Abstracts, Pollution Abstracts, PubMed, ProQuest Biological and Health Professional, and Scopus. (3) Results: Information on indoor exposure levels and determinants, emission sources, and associated health effects was extracted from 141 studies from 29 countries. The most-studied pollutants were particulate matter (PM2.5 and PM10); nitrogen dioxide (NO2); volatile organic compounds (VOCs) including benzene, toluene, xylenes and formaldehyde; and polycyclic aromatic hydrocarbons (PAHs) including naphthalene. Identified indoor PM2.5 sources include smoking, cooking, heating, use of incense, candles, and insecticides, while cleaning,

(1) Background: There is increasing awareness that the quality of the indoor environment affects our health and well-being.

housework, presence of pets and movement of people were the main sources of coarse particles. Outdoor air is a major PM2.5 source in rooms with natural ventilation in roadside households. Major sources of NO2 indoors are unvented gas heaters and cookers. Predictors of indoor NO2 are ventilation, season, and outdoor NO2 levels. VOCs are emitted from a wide range of indoor and outdoor sources, including smoking, solvent use, renovations, and household products. Formaldehyde levels are higher in newer houses and in the presence of new furniture, while PAH levels are higher in smoking households. High indoor particulate matter, NO2 and VOC levels were typically associated with respiratory symptoms, particularly asthma symptoms in children. (4) Conclusions: Household characteristics and occupant activities play a large role in indoor exposure, particularly cigarette smoking for PM2.5, gas appliances for NO2, and household products for VOCs and PAHs. Home location near high-traffic-density roads, redecoration, and small house size contribute to high indoor air pollution. In most studies, air exchange rates are negatively associated with indoor air pollution. These findings can inform interventions aiming to improve IAQ in residential properties in a variety of settings.

Authors: Sotiris Vardoulakis, Evanthia Giagloglou, Susanne Steinle, Alice Davis, Anne Sleeuwenhoek, Karen S Galea, Ken Dixon, Joanne O Crawford
Full Source: International journal of environmental research and public health 2020 Dec 2;17(23):E8972. doi: 10.3390/ijerph17238972.

Co-pyrolysis of food waste and wood bark to produce hydrogen with minimizing pollutant emissions

2020-11-21

In this study, the co-pyrolysis of food waste with lignocellulosic biomass (wood bark) in a continuous-flow pyrolysis reactor was considered as an effective strategy for the clean disposal and value-added utilization of the biowaste. To achieve this aim, the effects of major co-pyrolysis parameters such as pyrolysis temperature, the flow rate of the pyrolysis medium (nitrogen (N2) gas), and the blending ratio of food waste/wood bark on the yields, compositions, and properties of three-phase pyrolytic products (i.e., non-condensable gases, condensable compounds, and char) were investigated. The temperature and the food waste/wood bark ratio were found to affect the pyrolytic product yields, while the N2 flow rate did not. More non-condensable gases and less char were produced at higher temperatures. For example, as the temperature was increased from 300 °C to 700 °C, the yield of non-condensable gases increased from 6.3 to 17.5 wt%, while the yield of char decreased from 63.6 to 30.6 wt% for the

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co-pyrolysis of food waste and wood bark at a weight ratio of 1:1. Both the highest yield of hydrogen (H2) gas and the most significant suppression of the formation of phenolic and polycyclic aromatic hydrocarbon (PAH) compounds were achieved with a combination of food waste and wood bark at a weight ratio of 1:1 at 700 °C. The results suggest that the synergetic effect of food waste and lignocellulosic biomass during co-pyrolysis can be exploited to increase the H2 yield while limiting the formation of phenolic compounds and PAH derivatives. This study has also proven the effectiveness of co-pyrolysis as a process for the valorization of biowaste that is produced by agriculture, forestry, and the food industry, while reducing the formation of harmful chemicals.

Authors: Chanyeong Park, Nahyeon Lee, Jisu Kim, Jechan Lee
Full Source: Environmental pollution (Barking, Essex : 1987) 2020 Nov 21;116045. doi: 10.1016/j.envpol.2020.116045.

OCCUPATIONAL

Long-term exposure to low-level air pollution and incidence of chronic obstructive pulmonary disease: The ELAPSE project

2020-12-01

Background: Air pollution has been suggested as a risk factor for chronic obstructive pulmonary disease (COPD), but evidence is sparse and inconsistent.

Objectives: We examined the association between long-term exposure to low-level air pollution and COPD incidence.

Methods: Within the 'Effects of Low-Level Air Pollution: A Study in Europe' (ELAPSE) study, we pooled data from three cohorts, from Denmark and Sweden, with information on COPD hospital discharge diagnoses. Hybrid land use regression models were used to estimate annual mean concentrations of particulate matter with a diameter < 2.5 μm (PM2.5), nitrogen dioxide (NO2), and black carbon (BC) in 2010 at participants' baseline residential addresses, which were analysed in relation to COPD incidence using Cox proportional hazards models.

Results: Of 98,058 participants, 4,928 developed COPD during 16.6 years mean follow-up. The adjusted hazard ratios (HRs) and 95% confidence intervals for associations with COPD incidence were 1.17 (1.06, 1.29) per 5 μg/m3 for PM2.5, 1.11 (1.06, 1.16) per 10 μg/m3 for NO2, and 1.11 (1.06, 1.15) per 0.5 10-5m-1 for BC. Associations persisted in subset participants with PM2.5 or NO2 levels below current EU and US limit values and WHO

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guidelines, with no evidence for a threshold. HRs for NO2 and BC remained unchanged in two-pollutant models with PM2.5, whereas the HR for PM2.5 was attenuated to unity with NO2 or BC.
Conclusions: Long-term exposure to low-level air pollution is associated with the development of COPD, even below current EU and US limit values and possibly WHO guidelines. Traffic-related pollutants NO2 and BC may be the most relevant.
Authors: Shuo Liu, Jeanette T Jørgensen, Petter Ljungman, Göran Pershagen, Tom Bellander, Karin Leander, Patrik K E Magnusson, Debora Rizzuto, Ulla A Hvidtfeldt, Ole Raaschou-Nielsen, Kathrin Wolf, Barbara Hoffmann, Bert Brunekreef, Maciej Strak, Jie Chen, Amar Mehta, Richard W Atkinson, Mariska Bauwelinck, Raphaëlle Varraso, Marie-Christine Boutron-Ruault, Jørgen Brandt, Giulia Cesaroni, Francesco Forastiere, Daniela Fecht, John Gulliver, Ole Hertel, Kees de Hoogh, Nicole A H Janssen, Klea Katsouyanni, Matthias Ketzel, Jochem O Klompmaker, Gabriele Nagel, Bente Oftedal, Annette Peters, Anne Tjønneland, Sophia P Rodopoulou, Evangelia Samoli, Terese Bekkevold, Torben Sigsgaard, Massimo Stafoggia, Danielle Vienneau, Gudrun Weinmayr, Gerard Hoek, Zorana J Andersen
Full Source: Environment international 2020 Dec 1;146:106267. doi: 10.1016/j.envint.2020.106267.

Metabolic, immunologic, and histopathologic responses on premetamorphic American bullfrog (Lithobates catesbeianus) following exposure to lithium and selenium

2020-11-17
The presence of chemicals and the destruction of freshwater habitats have been addressed as one of the reasons for the decline in the amphibians' populations worldwide. Considering the threat that these animals have been suffering in tropical regions, the present study tested if the Brazilian legislation, concerning the permissive levels of lithium and selenium in water bodies and effluents, warrants the protection of aquatic life. To do so, we assessed the metabolic, immunologic, and histopathologic alterations in liver samples of American bullfrog (Lithobates catesbeianus), at the premetamorphic stage, through biomarkers indicative of general energetic status, i.e., glucose, lipid, and protein metabolism using biochemical and histochemical approaches. The immunologic responses were assessed by the quantification of melanomacrophage centres (MMCs); the histopathologic evaluation of the liver sections was also performed. The assay was carried out over 21 days with two periods of sampling (after 7 and 21 days) to assess the effects of exposure over time. The animals were exposed to the considered safe levels of lithium (2.5

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mg L-1) and selenium (10 µg L-1), both, isolated and mixed. The exposed animals showed alterations in glucose and lipid metabolism throughout the experiment. The intense presence of MMCs and histopathological responses are compatible with hepatotoxicity. The toxicity expressed by the employed animal model indicates that the Brazilian environmental legislation for the protection of aquatic life needs to be updated. With this study, we intend to provide data for better environmental policies and bring attention to sublethal effects triggered by the presence of contaminants in the aquatic environment.
Authors: Felipe Augusto Pinto-Vidal, Cleoni Dos Santos Carvalho, Fábio Camargo Abdalla, Letícia Ceschi-Bertoli, Heidi Samantha Moraes Utsunomiya, Renan Henrique da Silva, Raquel Fernanda Salla, Monica Jones-Costa
Full Source: Environmental pollution (Barking, Essex : 1987) 2020 Nov 17;116086. doi: 10.1016/j.envpol.2020.116086.

Serum dioxin concentrations in military workers at three dioxin-contaminated airbases in Vietnam

2020-11-23
An estimated 91,998,400 L of herbicides were stocked at three US airbases in Vietnam between 1962 and 1971. These herbicides were contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-tetraCDD). In 2017, we sampled blood from 120 male Vietnamese military workers in the three dioxin-contaminated airbases (Bien Hoa, Da Nang, and Phu Cat) and from 20 workers at an uncontaminated airbase. 2,3,7,8-tetraCDD concentrations were highest in samples from Bien Hoa (18.2 pg/g lipid), followed by samples from Da Nang (9.2 pg/g lipid), Phu Cat (3.7 pg/g lipid), and the reference base (2.1 pg/g lipid). In Bien Hoa, 31 of the 50 subjects had blood 2,3,7,8-tetraCDD levels in the range of 10-100 pg/g lipid and four subjects had 2,3,7,8-tetraCDD levels that exceeded 100 pg/g lipid. In Da Nang, almost half of the subjects had blood 2,3,7,8-tetraCDD concentrations in the range of 10-100 pg/g lipid. These findings suggest that military workers at contaminated bases are the population most vulnerable to dioxin exposure, especially at Bien Hoa.
Authors: Phan Van Manh, Pham The Tai, Nguyen Minh Phuong, Muneko Nishijo, Do Minh Trung, Pham Ngoc Thao, Ho Anh Son, Tran Van Tuan, Nguyen Van Chuyen, Nguyen Van Long, Nguyen Van Khoi, Nguyen Tung Linh, Hoang Van Luong, Do Ba Quyet
Full Source: Chemosphere 2020 Nov 23;129024. doi: 10.1016/j.chemosphere.2020.129024.

An estimated 91,998,400 L of herbicides were stocked at three US airbases in Vietnam between 1962 and 1971.

PHARAMACEUTICAL/TOXICOLOGY

Long-term exposure to fine particle elemental components and lung cancer incidence in the ELAPSE pooled cohort

2020-12-02

Background: An association between long-term exposure to fine particulate matter (PM2.5) and lung cancer has been established in previous studies. PM2.5 is a complex mixture of chemical components from various sources and little is known about whether certain components contribute specifically to the associated lung cancer risk. The present study builds on recent findings from the "Effects of Low-level Air Pollution: A Study in Europe" (ELAPSE) collaboration and addresses the potential association between specific elemental components of PM2.5 and lung cancer incidence.

Methods: We pooled seven cohorts from across Europe and assigned exposure estimates for eight components of PM2.5 representing non-tail pipe emissions (copper (Cu), iron (Fe), and zinc (Zn)), long-range transport (sulfur (S)), oil burning/industry emissions (nickel (Ni), vanadium (V)), crustal material (silicon (Si)), and biomass burning (potassium (K)) to cohort participants' baseline residential address based on 100 m by 100 m grids from newly developed hybrid models combining air pollution monitoring, land use data, satellite observations, and dispersion model estimates. We applied stratified Cox proportional hazards models, adjusting for potential confounders (age, sex, calendar year, marital status, smoking, body mass index, employment status, and neighborhood-level socio-economic status). Results: The pooled study population comprised 306,550 individuals with 3,916 incident lung cancer events during 5,541,672 person-years of follow-up. We observed a positive association between exposure to all eight components and lung cancer incidence, with adjusted HRs of 1.10 (95% CI 1.05, 1.16) per 50 ng/m3 PM2.5 K, 1.09 (95% CI 1.02, 1.15) per 1 ng/m3 PM2.5 Ni, 1.22 (95% CI 1.11, 1.35) per 200 ng/m3 PM2.5 S, and 1.07 (95% CI 1.02, 1.12) per 200 ng/m3 PM2.5 V. Effect estimates were largely unaffected by adjustment for nitrogen dioxide (NO2). After adjustment for PM2.5 mass, effect estimates of K, Ni, S, and V were slightly attenuated, whereas effect estimates of Cu, Si, Fe, and Zn became null or negative.

Conclusions: Our results point towards an increased risk of lung cancer in connection with sources of combustion particles from oil and biomass burning and secondary inorganic aerosols rather than non-exhaust traffic emissions. Specific limit values or guidelines targeting these specific

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PM2.5 components may prove helpful in future lung cancer prevention strategies.

Authors: Ulla Arthur Hvidtfeldt, Jie Chen, Zorana Jovanovic Andersen, Richard Atkinson, Mariska Bauwelinck, Tom Bellander, Jørgen Brandt, Bert Brunekreef, Giulia Cesaroni, Hans Concin, Daniela Fecht, Francesco Forastiere, Carla H van Gils, John Gulliver, Ole Hertel, Gerard Hoek, Barbara Hoffmann, Kees de Hoogh, Nicole Janssen, Jeanette Therming Jørgensen, Klea Katsouyanni, Karl-Heinz Jöckel, Matthias Ketzel, Jochem O Klompmaker, Alois Lang, Karin Leander, Shuo Liu, Petter L S Ljungman, Patrik K E Magnusson, Amar Jayant Mehta, Gabriele Nagel, Bente Oftedal, Göran Pershagen, Raphael Simon Peter, Annette Peters, Matteo Renzi, Debora Rizzuto, Sophia Rodopoulou, Evangelia Samoli, Per Everhard Schwarze, Gianluca Severi, Torben Sigsgaard, Massimo Stafoggia, Maciej Strak, Danielle Vienneau, Gudrun Weinmayr, Kathrin Wolf, Ole Raaschou-Nielsen

Full Source: Environmental research 2020 Dec 2;110568. doi: 10.1016/j.envres.2020.110568.