

# Bulletin Board

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## CHEMICAL EFFECTS

## Characterization of the role of esterases in the biodegradation of organophosphate, carbamate, and pyrethroid pesticides

2021-01-05

Ester-containing organophosphate, carbamate, and pyrethroid (OCP) pesticides are used worldwide to minimize the impact of pests and increase agricultural production. The toxicity of these chemicals to humans and other organisms has been widely reported. Chemically, these pesticides share an ester bond in their parent structures. A particular group of hydrolases, known as esterases, can catalyze the first step in ester-bond hydrolysis, and this initial regulatory metabolic reaction accelerates the degradation of OCP pesticides. Esterases can be naturally found in plants, animals, and microorganisms. Previous research on the esterase enzyme mechanisms revealed that the active sites of esterases contain serine residues that catalyze reactions via a nucleophilic attack on the substrates. In this review, we have compiled the previous research on esterases from different sources to determine and summarize the current knowledge of their properties, classifications, structures, mechanisms, and their applications in the removal of pesticides from the environment. This review will enhance the understanding of the scientific community when studying esterases and their applications for the degradation of broad-spectrum ester-containing pesticides.

Authors: Pankaj Bhatt, Xiaofan Zhou, Yaohua Huang, Wenping Zhang, Shaohua Chen

Full Source: Journal of hazardous materials 2021 Jan 5;411:125026. doi: 10.1016/j.jhazmat.2020.125026.

Ester-containing organophosphate, carbamate, and pyrethroid (OCP) pesticides are used worldwide to minimize the impact of pests and increase agricultural production.

## ENVIRONMENTAL RESEARCH

## Valuating environmental impacts from ship emissions - The marine perspective

2021-01-15

Shipping is an activity responsible for a range of different pressures affecting the marine environment, air quality and human welfare. The methodology on how ship emissions impact air quality and human health are comparatively well established and used in cost-benefit analysis of policy proposals. However, the knowledge base is not the same for impacts on the marine environment and a coherent environmental and

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socio-economic impact assessment of shipping has not yet been made. This risk policies to be biased towards air pollution whilst trading off impacts on the marine environment. The aim of the current study was to develop a comprehensive framework on how different pressures from shipping degrade marine ecosystems, air quality and human welfare. A secondary aim was to quantify the societal damage costs of shipping due to the degradation of human welfare in a Baltic Sea case study. By adding knowledge from marine ecotoxicology and life-cycle analysis to the existing knowledge from climate, air pollution and environmental economics we were able to establish a more comprehensive conceptual framework that allows for valuation of environmental impacts from shipping, but it still omits economic values for biological pollution, littering and underwater noise. The results for the Baltic Sea case showed the total annual damage costs of Baltic Sea shipping to be 2.9 billion €2010 (95% CI 2.0-3.9 billion €2010). The damage costs due to impacts on marine eutrophication (768 million €2010) and marine ecotoxicity (582 million €2010) were in the same range as the total damage costs associated with reduced air quality (816 million €2010) and climate change (737 million €2010). The framework and the results from the current study can be used in future socio-economic assessments of ship emissions to prioritize cost efficient measures. The framework can be used globally but the damage costs presented on the marine environment are restricted to emissions on the Baltic Sea and Kattegat region as they are based on willingness to pay studies conducted on citizens around the Baltic Sea where eutrophication and emissions of chemicals are particularly threats to the state of the Baltic Sea.

Authors: Erik Ytreberg, Stefan Åström, Erik Fridell

Full Source: Journal of environmental management 2021 Jan 15;282:111958. doi: 10.1016/j.jenvman.2021.111958.

## Association between particulate matter air pollution and risk of depression and suicide: a systematic review and meta-analysis

2021-01-22

An increasing number of studies examined the potential effects of ambient particulate matter (PM: PM2.5 and PM10-PMs with diameters not greater than 2.5 and 10 µm, respectively) pollution on the risk of depression and suicide; however, the results have been inconclusive. This study aimed to determine the overall relationship between PM exposure and depression/suicide based on current evidence. We conducted a systematic review and meta-analysis of current available studies. Thirty

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articles (20 for depression and 10 for suicide) with data from 1,447,313 participants were included in the meta-analysis. For a 10 µg/m<sup>3</sup> increase in short-term exposure to PM<sub>2.5</sub>, we found a 2% ( $p < 0.001$ ) increased the risk of depression and a 2% ( $p = 0.001$ ) increased risk of suicide. A 10 µg/m<sup>3</sup> increase in long-term exposure to PM<sub>2.5</sub> was associated with a more apparent increase of 18% ( $p = 0.005$ ) in depression risk. In addition, a 10 µg/m<sup>3</sup> increase in short-term exposure to PM<sub>10</sub> was associated with a 2% ( $p = 0.003$ ) increase in depression risk and a 1% ( $p = 0.002$ ) increase in suicide risk. Subgroup analyses showed that associations between PM and depression were more apparent in people over 65 years and from developed regions. Besides, the study design and study quality might also have an impact on their associations. The meta-analysis found that an increase in ambient PM concentration was strongly associated with an increased risk of depression and suicide, and the associations for depression appeared stronger for smaller particles (PM<sub>2.5</sub>) and at a long-term time pattern.

Authors: Qisijing Liu, Wanzhou Wang, Xuelin Gu, Furong Deng, Xueqin Wang, Hualiang Lin, Xinbiao Guo, Shaowei Wu  
Full Source: Environmental science and pollution research international 2021 Jan 22. doi: 10.1007/s11356-021-12357-3.

### Contaminants of emerging concern in aquatic environment: Occurrence, monitoring, fate, and risk assessment

2020-10

The present work provides a review focusing on contaminants of emerging concern (CECs) in aquatic environment, with an emphasis on their occurrence, monitoring, fate, and risk assessment in the research published in the scientific literature in 2019. Several studies revealed that these organic contaminants were detected in many water bodies and suspect, nontarget, and target screening provided an efficient detection for the co-existing organic substances with complex components. Wastewater resource recovery facilities were concurrently considered as a central source, and several specific chemicals have been found to be used as chemical markers to track the source of CECs in some urban watersheds. Reliable monitoring, reliable fate/toxicity assessment, and effective removal that consider CECs as a heterogeneous group rather

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than single substances will be the challenges for the research community in the future.

Authors: Yankui Tang, Yaxuan Zhong, Huilan Li, Yiting Huang, Xinye Guo, Fan Yang, Yu Wu

Full Source: Water environment research : a research publication of the Water Environment Federation 2020 Oct;92(10):1811-1817. doi: 10.1002/wer.1438.

### OCCUPATIONAL

#### Organophosphate pesticide exposure, hormone levels, and interaction with PON1 polymorphisms in male adolescents

2021-01-17

Objective: To examine the association between urinary metabolites of organophosphate (OP) pesticides and serum concentrations of thyroid and reproductive hormones in male adolescents and to assess the potential effect of interactions between OP pesticides and paraoxonase 1 (PON1) polymorphisms on hormone levels.

Methods: Study subjects (N = 117) were male 16- to 17-year-olds from the Environment and Childhood (INMA)-Granada cohort in Spain. Concentrations of 3,5,6-trichloro-2-pyridinol (TCPy), a metabolite of chlorpyrifos/chlorpyrifos-methyl, 2-isopropyl-6-methyl-4-pyrimidinol (IMPy), a metabolite of diazinon, and diethylthiophosphate (DETP) and diethyldithiophosphate (DEDTP), non-specific metabolites of OP pesticides, were measured in a spot urine sample from each subject and adjusted for creatinine. Levels of reproductive hormones (total testosterone [TT], estradiol [E2], dehydroepiandrosterone sulfate [DHEAS], sex hormone binding globulin [SHBG], luteinizing hormone [LH], follicle stimulating hormone [FSH], anti-Müllerian hormone [AMH], insulin growth factor 1 [IGF-1], and prolactin), thyroid hormones (free thyroxine [FT4], total triiodothyronine [TT3], and thyroid stimulating hormone [TSH]), and PON1 Q192R and L55M polymorphisms were determined in blood drawn during the same clinical visit. Results: Multiple linear regression models showed that detectable levels of TCPy were associated with an increase in DHEAS and decreases in E2, FSH, and AMH; detectable IMPy with increases in E2, DHEAS, FSH, AMH, and prolactin and decreases in SHBG and LH; and detectable DETP with marginally-significant increases in TT and TT3 and decreases in FSH, AMH, and prolactin. The effect of IMPy and DETP on DHEAS and TT levels, respectively, was higher in subjects that carried the PON1 55MM genotype, while the effect of TCPy, IMPy, and

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DETP on thyroid hormone levels was higher in PON1 192QR/RR or 55MM genotype carriers.

Conclusions: In male adolescents, non-occupational exposure to OP pesticides was associated with several changes in reproductive and thyroid hormone levels, and the magnitude of some associations was greater in adolescents genetically more susceptible to OP pesticide exposure who carry the PON1 55MM genotype.

Authors: Beatriz Suárez, Fernando Vela-Soria, Francesca Castiello, Alicia Olivas-Martinez, Dario Acuña-Castroviejo, José Gómez-Vida, Nicolás Olea, Mariana F Fernández, Carmen Freire

Full Source: The Science of the total environment 2021 Jan 17;769:144563. doi: 10.1016/j.scitotenv.2020.144563.

### Heavy Metal Exposure Leads to Rapid Changes in Cellular Biophysical Properties

2020-04-13

Biophysical properties of cells, such as cell mechanics, cell shape, and cell migration, are emerging hallmarks for characterizing various cell functions. Conversely, disruptions to these biophysical properties may be used as reliable indicators of disruptions to cell homeostasis, such as in the case of chemical-induced toxicity. In this study, we demonstrate that treatment of lead(II) nitrate and cadmium nitrate leads to dosage-dependent changes in a collection of biophysical properties, including cellular traction forces, focal adhesions, mechanical stiffness, cell shape, migration speed, permeability, and wound-healing efficacy in mammalian cells. As those changes appear within a few hours after the treatment with a trace amount of lead/cadmium, our results highlight the promise of using biophysical properties to screen environmental chemicals to identify potential toxicants and establish dose response curves. Our systematic and quantitative characterization of the rapid changes in cytoskeletal structure and cell functions upon heavy metal treatment may inspire new research on the mechanisms of toxicity.

Authors: Peiran Zhu, Jamar Hawkins, Will Hamilton Linthicum, Menglin Wang, Ningwei Li, Nanjia Zhou, Qi Wen, Alicia Timme-Laragy, Xiaofei Song, Yubing Sun

Full Source: ACS biomaterials science & engineering 2020 Apr 13;6(4):1965-1976. doi: 10.1021/acsbomaterials.9b01640.

Biophysical properties of cells, such as cell mechanics, cell shape, and cell migration, are emerging hallmarks for characterizing various cell functions.

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### Occupational exposure of rural workers to pesticides in a vegetable-producing region in Brazil

2021-01-20

The health of family farmers is at risk due to occupational exposure to pesticides. The aims of the current study were to investigate the level of farmers' perception of risks associated with pesticide use and to assess their health condition based on biochemical and immunological tests. Family farmers living in a vegetable-producing region in Southern Brazil were selected to participate in the study. More than 70% of the family farmers were often exposed to more than one type of pesticides; 41.2% were intensively using several pesticides for more than one decade and 74.4% were not using personal protective equipment (PPE) at the time of pesticide handling due to low perception of the risks posed by these chemicals. Enzymatic analysis performed in participants' blood samples showed changes in catalase (CAT) and glutathione reductase (GR) activity, in lipid peroxidation (TBARS) and carbonylated protein levels, as well as in chemoattractant (IL-8) and anti-inflammatory (IL-10) interleukin expression. Low perception of health-related risks posed by pesticides can be attributed to factors such as low schooling and lack of information, which put farmers' health at risk, as evidenced by blood biochemical and immunological changes.

Authors: Eloisa Lovison Sasso, Roberta Cattaneo, Tamiris Rosso Storck, Mariana Spanemberg Mayer, Voltaire Sant'Anna, Barbara Clasen

Full Source: Environmental science and pollution research international 2021 Jan 20. doi: 10.1007/s11356-021-12444-5.

The health of family farmers is at risk due to occupational exposure to pesticides.

## PHARMACEUTICAL/TOXICOLOGY

### Quantification of systemic o-toluidine after intrathecal administration of hyperbaric prilocaine in humans: a prospective cohort study

2021-01-21

Hyperbaric 2% prilocaine is increasingly used for spinal anesthesia. It is the only local anesthetic metabolized to o-toluidine, a human bladder carcinogen. Increase of o-toluidine hemoglobin adducts, a marker of o-toluidine ability to modify the DNA structure, was described following subcutaneous injection. In this prospective cohort study we aimed to assess and quantify o-toluidine hemoglobin adducts and urinary o-toluidine after a single intrathecal dose of hyperbaric prilocaine. 10 patients undergoing surgery received 50 mg of hyperbaric prilocaine

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intrathecally. Blood and urine samples were collected before injection and up to 24 h later (Hospital Braine l'Alleud-Waterloo, Braine l'Alleud, Belgium). Urinary o-toluidine and o-toluidine hemoglobin adducts were measured by tandem mass-spectrometry after gas-chromatographic separation (Institute of the Ruhr-Universität, Bochum Germany). The trial was registered to ClinicalTrials.gov (NCT03642301; 22-08-2018) Intrathecal administration of 50 mg of hyperbaric prilocaine leads to a significant increase of o-toluidine hemoglobin adducts ( $0.1 \pm 0.02$ - $11.9 \pm 1.9$  ng/g Hb after 24 h,  $p = 0.001$ ). Peak of urinary o-toluidine was observed after 8 h ( $0.1 \pm 0.1$ - $460.5 \pm 352.8$   $\mu\text{g/L}$ ,  $p = 0.001$ ) and declined to  $98 \pm 66.8$   $\mu\text{g/L}$  after 24 h (mean  $\pm$  SD) Single intrathecal administration of hyperbaric prilocaine leads to a systemic burden with o-toluidine and o-toluidine hemoglobin adducts. O-toluidine-induced modifications of DNA should be examined and intrathecal hyperbaric prilocaine should not be proposed to patients chronically exposed to o-toluidine. Clinical trial number and registry URL NCT03642301.

Authors: Emmanuel Guntz, Andrea Carini, Stephan Koslitz, Thomas Brüning, Panayota Kapessidou, Tobias Weiss

Full Source: Archives of toxicology 2021 Jan 21. doi: 10.1007/s00204-021-02973-w.

### Carcinogenicity and chronic toxicity of acrolein in rats and mice by two-year inhalation study

2021-01-16

The carcinogenicity and chronic toxicity of acrolein was examined by whole body inhalation to groups of 50 F344/DuCrCrj rats and 50 B6D2F1/Crlj mice of both sexes for two years. The concentration of acrolein was 0, 0.1, 0.5 or 2 ppm (v/v) for male and female rats; and 0, 0.1, 0.4 or 1.6 ppm for male and female mice. Two-year administration of acrolein induced the squamous cell carcinomas in nasal cavity which is rare tumor in one male and two female rats. In females, rhabdomyoma in nasal cavity was observed in four rats exposed to 2 ppm. In mice, since the survival rate of male and female of mice control group were lowered than 25% in late of the administration periods due to renal lesion and/or amyloid deposition, the mice study was terminated at 93rd week in males, and was terminated at 99th week in females. The incidences of adenomas in nasal cavity were observed in 16 females and significantly increased only in female mice. Thus, acrolein is carcinogenic in two species, i.e. rats and mice.

The carcinogenicity and chronic toxicity of acrolein was examined by whole body inhalation to groups of 50 F344/DuCrCrj rats and 50 B6D2F1/Crlj mice of both sexes for two years.

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Additionally, non-neoplastic nasal cavity lesions in rats and mice were observed.

Authors: Michiharu Matsumoto, Shotaro Yamano, Hideki Senoh, Yumi Umeda, Shigeyuki Hirai, Arata Saito, Tatsuya Kasai, Shigetoshi Aiso

Full Source: Regulatory toxicology and pharmacology : RTP 2021 Jan 16;104863. doi: 10.1016/j.yrtph.2021.104863.

### Assessment of the Influence of Crystalline Form on Cyto-Genotoxic and Inflammatory Effects Induced by TiO<sub>2</sub> Nanoparticles on Human Bronchial and Alveolar Cells

2021-01-19

Titanium dioxide nanoparticles (TiO<sub>2</sub>NPs) are increasingly used in consumer products, industrial and medical applications, raising concerns on their potential toxicity. The available in vitro and in vivo studies on these NPs show controversial results. Crystalline structure is the physicochemical characteristic that seems to influence mainly TiO<sub>2</sub>NPs toxicity, so its effect needs to be further studied. We aimed to study whether and how crystalline form influences potential cyto-genotoxic and inflammatory effects induced by two commercial TiO<sub>2</sub>NPs (TiO<sub>2</sub>-A, mainly anatase; TiO<sub>2</sub>-B, mainly rutile) in human alveolar A549 and bronchial BEAS-2B cells exposed to 1-40  $\mu\text{g/mL}$ . Cell viability (WST-1), membrane damage (LDH release), IL-6, IL-8 and TNF- $\alpha$  release (ELISA) and direct/oxidative DNA damage (fpg-comet assay) were evaluated. Physicochemical characterization included analysis of crystalline form (TEM and XRD), specific surface area (BET), agglomeration (DLS) and Z-potential (ELS). Our results show that TiO<sub>2</sub>-A NPs induce in BEAS-2B cytotoxicity and a slight inflammation and in A549 slight oxidative effects, whereas TiO<sub>2</sub>-B NPs induce genotoxic/oxidative effects in both cell lines, revealing different toxicity mechanisms for the two tested NPs. In conclusion, our study confirms the influence of crystalline form on cellular response, also demonstrating the suitability of our in vitro model to screen early TiO<sub>2</sub>NPs effects.

Authors: Anna Maria Fresegna, Cinzia Lucia Ursini, Aureliano Ciervo, Raffaele Maiello, Stefano Casciardi, Sergio Iavicoli, Delia Cavallo

Full Source: Nanomaterials (Basel, Switzerland) 2021 Jan 19;11(1):253. doi: 10.3390/nano11010253.

Titanium dioxide nanoparticles (TiO<sub>2</sub>NPs) are increasingly used in consumer products, industrial and medical applications, raising concerns on their potential toxicity.