

# Bulletin Board

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## CHEMICAL EFFECTS

## Occurrence and fate of androgens, progestogens and glucocorticoids in two swine farms with integrated wastewater treatment systems

2021-01-14

Steroid hormones are endocrine-disrupting chemicals that can cause adverse effects even at trace levels. The information about steroid hormones in animal wastes is still very limited. Here we investigated the occurrence and fate of fourteen androgens, twenty-one progestogens, and five glucocorticoids in Farm Luo Cheng (LC) and Farm Shui Tai (ST) with integrated wastewater treatment systems (WTSs) in South China. These two integrated systems have four stages: primary treatment (primary sedimentation tank), secondary biological treatment (biogas digester and up-flow anaerobic sludge reaction bed (UASB)), third-stage disinfection process, and fourth-stage dilution and further biodegradation process (oxidation fish ponds/lagoons). A total of 31 target steroid hormones were detected in the wastewater of the two swine farms, with concentrations ranging from 0.12 ng/L (medroxyprogesterone acetate, MPA) to 11,200 ng/L (5 $\alpha$ -dihydroprogesterone, 5 $\alpha$ -DHP). A total of 22 target steroid hormones were detected in feces, of which 19 were detected in Farm LC and 17 in Farm ST. Some of these detected steroids were synthetic chemicals, which might be parent chemicals from exogenous addition or their metabolites, or transformation products from other natural steroids. The steroids excretion of sows in swine farms were estimated, with some steroids such as androstenedione (AED, 41.5  $\mu$ g/d), epiandrosterone (EADR, 268  $\mu$ g/d), progesterone (P, 661  $\mu$ g/d), and 5 $\alpha$ -DHP (982 $\mu$ g/d) having much higher values than those from human bodies. Both WTSs in the swine farms could effectively remove the target steroid hormones, with the removal rates of most targets exceeding 90%. In comparison, the anaerobic digester-A2/O (anaerobic-anoxic-oxic)-lagoon system performed better in removing steroids than the up-flow anaerobic sludge reaction bed (UASB)-two-stage series (A/O)2-oxidation fish ponds system. However, there were still 22 steroid hormones, including 14 synthetic ones detected in the effluent, with the risk quotients of most synthetic steroids exceeding 1, showing high risks to aquatic organisms. The findings from this study showed that there is a wide presence of steroid hormones, especially some synthetic steroids in

Steroid hormones are endocrine-disrupting chemicals that can cause adverse effects even at trace levels.

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animal wastes, posing potential ecological risks, and these steroids should be removed before discharge to the environment.

Authors: Jin-Na Zhang, Jun Chen, Lei Yang, Min Zhang, Li Yao, You-Sheng Liu, Jian-Liang Zhao, Bing Zhang, Guang-Guo Ying

Full Source: Water research 2021 Jan 14;192:116836. doi: 10.1016/j.watres.2021.116836.

## Occurrence and toxicity of halobenzoquinones as drinking water disinfection byproducts

2021-01-21

Halobenzoquinones (HBQs) are emerging unregulated drinking water disinfection byproducts (DBPs) that are more toxic than regulated DBPs. This study aimed to determine the distribution and formation of HBQs in drinking water from water treatment plants in China, compare their chronic cytotoxicity and their induction of chromosomal damage in Chinese hamster ovary cells, and analyze the correlation of HBQ toxicity with their physicochemical parameters. Two HBQs, 2,6-dichloro-1,4-benzoquinone (2,6-DCBQ) and 2,6-dibromo-1,4-benzoquinone (2,6-DBBQ), were detected in finished water and tap water in China. The concentrations were in the ranges of <2.6-19.70 ng/L for 2,6-DCBQ and <0.38-1.8 ng/L for 2,6-DBBQ. Chemical oxygen demand and residual chlorine were positively correlated with HBQ formation. The HBQ concentration was lower in a drinking water treatment plant using chlorine dioxide. High Ca<sup>2+</sup> in tap water decreased the HBQ level. The rank order of HBQ by cytotoxicity was 2-chloro-1,4-benzoquinone > 2,3-diiodo-1,4-benzoquinone > 2,6-diiodo-1,4-benzoquinone > 2,6-dibromo-1,4-benzoquinone > 2,5-dibromo-1,4-benzoquinone > 2,5-dichloro-1,4-benzoquinone > 2,6-dichloro-1,4-benzoquinone > tetrachloro-1,4-benzoquinone > 2,3,6-trichloro-1,4-benzoquinone, and for their genotoxicity, 2,5-dichloro-1,4-benzoquinone > 2,6-dichloro-1,4-benzoquinone > 2,3-diiodo-1,4-benzoquinone > 2,6-diiodo-1,4-benzoquinone > tetrachloro-1,4-benzoquinone > 2,5-dibromo-1,4-benzoquinone > 2,6-dibromo-1,4-benzoquinone > 2,3,6-trichloro-1,4-benzoquinone. The cytotoxicity of six dihalo-HBQs was negatively correlated with the octanol-water partition coefficient ( $r = -0.971$ ,  $P < 0.05$ ), molar refractivity ( $r = -0.956$ ,  $P < 0.05$ ), energy of the highest occupied molecular orbital (EHOMO) ( $r = -0.943$ ,  $P < 0.05$ ), and polar surface area ( $r = -0.829$ ,  $P < 0.05$ ). The genotoxicity of these three pairs of dihalo-HBQ isomers followed the same order as their EHOMO values. This study reveals the occurrence and

Halobenzoquinones (HBQs) are emerging unregulated drinking water disinfection byproducts (DBPs) that are more toxic than regulated DBPs.

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formation of HBQs in drinking water in China and systematically evaluates the chromosomal damage caused by nine HBQs in mammalian cells.

Authors: Huan Wu, Kunling Long, Yujie Sha, Du Lu, Ying Xia, Yan Mo, Qiyuan Yang, Weiwei Zheng, Mengting Yang, Xiao Wei

Full Source: The Science of the total environment 2021 Jan 21;770:145277. doi: 10.1016/j.scitotenv.2021.145277.

### A review of potentially harmful chemicals in crumb rubber used in synthetic football pitches

2020-12-31

Recycling end-of-life tires (ELTs) reduces waste and provides a low-cost source of energy and materials such as crumb rubber, used as infill in artificial turf football pitches. However, some concerns were raised and remain about its safety. The potentially toxic human exposure to chemicals such as polycyclic aromatic hydrocarbons (PAHs), metals and others (volatile organic compounds (VOCs), plasticizers, antioxidants and additives) existing in ELTs (and in the resulting crumb rubber) is being studied, with no definitive conclusions. The literature existing so far suggests the possibility of their release from synthetic turf infill into the environment as water leachates and to the air surrounding the pitches, but there is the need of further research, also to assess the contribution of other materials present in synthetic turf. The database available comprised crumb rubber infill studies from pitches in 6 countries (USA, Norway, Netherlands, Portugal, Italy, Spain) and revealed a myriad of hazardous chemicals, with benzo[a]pyrene (n.d.- $4.31 \pm 3.95$  mg/kg) and zinc (n.d.- $14150 \pm 1344$  mg/kg) often exceeding the established limits. A dependence on indoor/outdoor conditions and the age of the source material was evaluated, often showing significant differences. From this standpoint, this review is intended to add knowledge about the presence of contaminants in this recycled material, aiming to ensure the safety of end-users and the environment.

Authors: Filipa O Gomes, M Rosário Rocha, Arminda Alves, Nuno Ratola  
Full Source: Journal of hazardous materials 2020 Dec 31;409:124998. doi: 10.1016/j.jhazmat.2020.124998.

Recycling end-of-life tires (ELTs) reduces waste and provides a low-cost source of energy and materials such as crumb rubber, used as infill in artificial turf football pitches.

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## ENVIRONMENTAL RESEARCH

### New methodologies for the detection, identification, and quantification of microplastics and their environmental degradation by-products

2021-01-27

Sampling, separation, detection, and characterization of microplastics (MPs) dispersed in natural water bodies and ecosystems is a challenging and critical issue for a better understanding of the hazards for the environment posed by such nearly ubiquitous and still largely unknown form of pollution. There is still the need for exhaustive, reliable, accurate, reasonably fast, and cost-efficient analytical protocols allowing the quantification not only of MPs but also of nanoplastics (NPs) and of the harmful molecular pollutants that may result from degrading plastics. Here a set of newly developed analytical protocols, integrated with specialized techniques such as pyrolysis-gas chromatography-mass spectrometry (Py-GC/MS), for the accurate and selective determination of the polymers most commonly found as MPs polluting marine and freshwater sediments are presented. In addition, the results of an investigation on the low molecular weight volatile organic compounds (VOCs) released upon photo-oxidative degradation of microplastics highlight the important role of photoinduced fragmentation at a molecular level both as a potential source of hazardous chemicals and as accelerators of the overall degradation of floating or stranded plastic debris.

Authors: Valter Castelvetro, Andrea Corti, Greta Biale, Alessio Ceccarini, Ilaria Degano, Jacopo La Nasa, Tommaso Lomonaco, Antonella Manariti, Enrico Manco, Francesca Modugno, Virginia Vinciguerra

Full Source: Environmental science and pollution research international 2021 Jan 27. doi: 10.1007/s11356-021-12466-z.

### Air pollution and indoor settings

2021-01-07

Indoor environments contribute significantly to total human exposure to air pollutants, as people spend most of their time indoors. Household air pollution (HAP) resulting from cooking with polluting ("dirty") fuels, which include coal, kerosene, and biomass (wood, charcoal, crop residues, and animal manure) is a global environmental health problem. Indoor pollutants are gases, particulates, toxins, and microorganisms among others, that can have an impact especially on the health of children and adults through a combination of different mechanisms on oxidative stress

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and gene activation, epigenetic, cellular, and immunological systems. Air pollution is a major risk factor and contributor to morbidity and mortality from major chronic diseases. Children are significantly affected by the impact of the environment due to biological immaturity, prenatal and postnatal lung development. Poor air quality has been related to an increased prevalence of clinical manifestations of allergic asthma and rhinitis. Health professionals should increase their role in managing the exposure of children and adults to air pollution with better methods of care, prevention, and collective action. Interventions to reduce household pollutants may promote health and can be achieved with education, community, and health professional involvement.

Authors: Nelson Augusto Rosário Filho, Marilyn Urrutia-Pereira, Gennaro D'Amato, Lorenzo Cecchi, Ignacio J Ansotegui, Carmen Galán, Anna Pomés, Margarita Murrieta-Aguttes, Luis Caraballo, Philip Rouadi, Herberto J Chong-Neto, David B Peden

Full Source: The World Allergy Organization journal 2021 Jan 7;14(1):100499. doi: 10.1016/j.waojou.2020.100499.

### Advances and limitations in the determination and assessment of gunshot residue in the environment

2021-01-15

Gunshot residue (GSR) stemming from the discharge of firearms has been essential to advancements in the field of forensic science however the human and environmental health impacts from GSR are far less researched. GSR represents a multifaceted concern: it contains a complex mixture of inorganic and organic components and produces airborne particles with variable sizes, depositions, and fates. Herein we evaluate studies in the literature examining GSR collection, deposition, composition, environmental contamination, and potential remediation techniques within the last two decades (2000 - 2020). Throughout we reflect upon key findings and weaknesses in relation to environmental characterization of GSR and associated firearm contaminants. Research focused on techniques to analyze both inorganic and organic GSR simultaneously has begun, but requires additional effort. A vast majority of the available environmental characterization literature focuses on soil contamination at outdoor firing ranges for a select number of elements (Cu, Pb, Sb) with comparisons between ranges or at different collection distances and depths. There is limited ability for between study comparisons due to collection and analysis differences as well as a lack of background soil sampling. Notably, these studies lack direct quantification of the contribution of contaminants from GSR as well as analysis of organic

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compounds. Currently, there is a need for air monitoring to determine the composition, deposition, and fate of GSR, particularly in outdoor settings. This review summarizes the collection, characterization, and environmental studies related to GSR and highlights areas of research needed to establish the environmental health impacts.

Authors: Oscar Black, Samuel Cole Smith, Courtney Roper

Full Source: Ecotoxicology and environmental safety 2021 Jan 15;208:111689. doi: 10.1016/j.ecoenv.2020.111689.

### Municipal Solid Waste Recycling: Impacts on Energy Savings and Air Pollution

2021-01-28

In recent years, recycling of municipal solid waste (MSW) has been recognized as one of the most efficient methods of waste management in terms of environmental benefits. This study investigates the energy savings and other environmental benefits of recycling of dry MSW collected in Shiraz, Iran (2018). The impact of different recycling rates (current = 15%, desirable = 50%, ideal = 80%) on environmental benefits and energy savings were assessed. The annual quantity of recycled components were defined as glass (735 tons), plastic carrier bags (555 tons), cardboard (3,874 tons), paper (3,806 tons), disposable plastic containers (287 tons), other types of metals (785 tons), disposable metallic containers (aluminum) (171 tons), other types of plastics (812 tons) and polyethylene terephthalate (PET) (887 tons). The results confirmed that recycling of paper and glass in three different scenarios resulted in a reduction of 1.01, 2.14, and 3.43 million tons of air pollutant emissions, respectively. By improving the recycling rates from 15 to 80%, overall energy savings can improve by between a factor of 3.5 to 5.5. Also, a reduction of approximately 2-3.5% in air pollutant emissions can be achieved by upgrading the current recycling program (15% recycling rate) to favorable and ideal conditions.

Authors: Mahdi Farzadkia, Amir Hossein Mahvi, Abbas Norouzian Baghani, Armin Sorooshian, Mahdiah Delikhoon, Razieh Sheikhi, Qadir Ashournejad

Full Source: Journal of the Air & Waste Management Association (1995) 2021 Jan 28. doi: 10.1080/10962247.2021.1883770.

In recent years, recycling of municipal solid waste (MSW) has been recognized as one of the most efficient methods of waste management in terms of environmental benefits.

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## OCCUPATIONAL

### Low levels of knowledge and practice of occupational hazards among flower farm workers in southwest Shewa zone, Ethiopia: a cross-sectional analysis

2021-01-28

**Background:** Over the last decade, flower farms have been rapidly growing in Ethiopia. Following the advent and development of the sector, various work-related chemical, biological, physical, psychosocial, and ergonomic hazards have been emerging unacceptably, with increased risks of exposures for workers and local communities. However, evidence that describes knowledge and prevention practice of occupational hazards among flower farm workers in the country is little documented. The knowledge and safety practice of occupational hazards among flower farm workers in Ethiopia were explored in the current study.

**Methods:** A cross-sectional survey of 471 flower farm workers was implemented from March to April 2017. A stratified random sampling technique was used to select the eligible participants. An interviewer-administered questionnaire was used to collect data, and the data were entered in to Epi Info program version 7 and analyzed by SPSS program version 20. Bivariate and multivariate linear regression analyses were performed to evaluate significance of associations at < 0.05 p-values.

**Results:** A total of 451 flower farm workers were interviewed with a response rate of 95.7%. The majority, 72.1% (N = 325) were females. Mean age was 24.1 (SD + 6.5) years. About 39.2% (N = 177) of the participants had good knowledge on occupational hazards. The level of safety practice was 26.6% (N = 120). The level of knowledge on occupational hazards was affected by level of education [AOR: 20.03;95% CI (16.30,23.75)], work experience [AOR: 5.97; 95% CI (4.22,7.72)], and type of employment [AOR: 5.35; 95% CI (2.50,8.19)], whereas the level of safety practice was influenced by regular use of personal protective equipment (PPE) [AOR:17.53;95% CI (13.36,21.71)], level of knowledge [AOR: 7.29; 95% CI (3.87,10.73)], and provision of appropriate PPE [AOR: 4.59; 95% CI (2.34,8.86)].

**Conclusion:** This study revealed the levels of knowledge and safety practice towards occupational hazards were low. The knowledge on occupational hazards was significantly affected by the level of education and duration of employment. Moreover, the use of PPE and level of knowledge considerably influenced safety practice. Therefore, we recommend employers to ensure that workplace health and safety programs account for workers' level of education and work experience. It

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is also pivotal to provide workers with suitable PPE and instructions on its use, and to arrange safety communication in the local languages at the relevant workplaces.

Authors: Debela Hinsermu Geleta, Mekuriaw Alemayehu, Geta Asrade, Tesfaye Hambisa Mekonnen

Full Source: BMC public health 2021 Jan 28;21(1):232. doi: 10.1186/s12889-021-10254-5.

### Rheumatoid arthritis in low-level toluene-exposed workers based on nationwide medical surveillance data in Korea

2021-01-29

**Background:** There is growing evidence that exposure to organic solvents can play a role in the etiology of rheumatoid arthritis (RA). This prospective cohort study aimed to investigate the association between RA and toluene exposure.

**Methods:** The study cohort consisted of Korea Occupational Safety and Health Agency data from male workers exposed to toluene who had undergone a toluene-associated special medical examination at least once between January 1, 2000 and December 31, 2004 (n = 148,870). The morbidity from RA based on hospital admission records was estimated from 2000 to 2005 using National Health Insurance Claim Data. The standardized admission ratio (SAR) for RA was calculated with reference to the general population. Levels of urinary hippuric acid (HA), a metabolite of toluene, were measured and used for exposure assessment.

**Results:** Toluene-exposed workers were at an elevated risk of seropositive rheumatoid arthritis (ICD-10 code M05) with an SAR of 2.38 (95% confidence interval [CI]: 1.14-4.37) and other rheumatoid arthritis (M06) with an SAR of 1.22 (95% CI: 0.91-1.59). When data were stratified according to the duration of toluene exposure and by tertiles of urinary HA level, no significant difference was apparent.

**Conclusion:** SARs of the toluene-exposed workers are higher than that of the general reference population, indicating that exposure to toluene may contribute to an increased risk of RA. Further studies of toluene-exposed workers with longer follow-up are needed.

Authors: Young-Sun Min, Sungho Lee, Mingi Kim, Yeon-Soon Ahn

Full Source: American journal of industrial medicine 2021 Jan 29. doi: 10.1002/ajim.23226.

**Background:** There is growing evidence that exposure to organic solvents can play a role in the etiology of rheumatoid arthritis (RA).

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### PHARAMACEUTICAL/TOXICOLOGY

#### Protective effect of thymoquinone against lung intoxication induced by malathion inhalation

2021-01-28

Malathion is considered one of the vastest pesticides use all over the world. Malathion-inhalation toxicity commonly occurred in many occupational farmers. Therefore, this study aimed to ameliorate the possible malathion-induced pulmonary toxicity through thymoquinone administration. Forty animals were used to conduct our study, divided into five groups; G1 control group, G2 thymoquinone (50 mg/kg) group, G3 malathion group (animals inhaled 100 mg/ml/m<sup>3</sup> for 15 min for 5 days/week for three weeks), G4 and G5 were subjected to the same malathion inhalation protocol beside oral thymoquinone administration at doses of 25 and 50 (mg/kg), respectively. Malathion-inhalation induced marked systemic toxicity as hepatotoxicity and nephrotoxicity associated with increased serum hepatic and renal enzymes, and hypersensitivity accompanied with increased total IgE serum level. The lung showed severe interstitial pneumonia associated with severe vascular damage and marked eosinophil infiltration. Moreover, the lung showed a marked decrease in the pulmonary surfactant protein, especially SP-D gene expression. While, thymoquinone treatment to malathion-inhaled animals decremented the following; hepatic enzymes and renal function tests, total IgE as well as pneumonia and hypersensitivity pathological features, and augmented the expression of SP-D. In conclusion, thymoquinone could be potentially used in pest control workers to ameliorate the systemic and pulmonary intoxication caused by one of the most field-used pesticides.

Authors: Walied Abdo, Mostafa A Elmadawy, Ehab Yahya Abdelhiee, Mona A Abdel-Kareem, Amira Farag, Mohamed Aboubakr, Emad Ghazy, Sabreen E Fadl

Full Source: Scientific reports 2021 Jan 28;11(1):2498. doi: 10.1038/s41598-021-82083-w.

Malathion is considered one of the vastest pesticides use all over the world.