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CHEMICAL EFFECTS

Elucidation of 28 day repeated oral dose induced genotoxicity potential of nickel (II) oxide nanoparticles in Wistar albino rats

2025-05-22
Nanotechnology has revolutionized industrial processing and human life by the applications of nanoparticles (NPs), especially the metal oxide ones. Nickel oxide (NiO) NPs have been used in applications including electronics and biosensors. Occupational and accidental exposure to these NPs for longer durations is apparent and the same may lead to significant health risks. In the present study, we have elucidated the genotoxic ability of NiO-NPs post repeated oral exposure for 28 days in Wistar albino rats at 50, 100, and 200 mg/kg body weight doses. A dose dependent percentage tail DNA was recorded in the peripheral blood lymphocyte, liver and bone marrow cells on rats at all the doses tested. The micronucleus and CA tests using bone marrow cells showed the prominent DNA damage potential of NiO-NPs corroborating the comet assay results. Primary interaction of NiO-NPs or nickel ions generated from NiO-NPs and secondary interaction of reactive oxygen species generated in response to NiO-NPs toxic insult with the DNA are the suspected reasons for observed genotoxicity. This study highlights the probability of DNA damaging effects in non-target organisms when exposed to NiO-NPs for a long time. Investigations to elucidate the NiO-NPs mediated adverse effects on terrestrial organisms are warranted.
Authors: Naresh Dumala, Srilekha Chintala, Bhanuramya Mangalampalli, Rekhadevi Perumalla Venkata
Full Source: Regulatory toxicology and pharmacology : RTP 2025 May 22:105858. doi: 10.1016/j.yrtph.2025.105858.

Phosphate perils in marine aquaculture: Systematic toxicity assessment in turbot juveniles in cultivation

2025-10
Recirculating Aquaculture Systems (RAS) aim to minimize water usage while maintaining optimal conditions for aquatic organisms, which is increasingly recognized as a crucial strategy for advancing sustainable aquaculture practices and enhancing global food security. However, many current marine RAS lack efficient treatments for removing dissolved wastes like phosphates (PO43--P), impacting water quality and potentially affecting the health of cultured organisms. Here, juveniles

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of turbot (Scophthalmus maximus), a promising and growing marine culture species, were exposed to PO43--P at different concentrations for 60 days to evaluate systematic responses and toxicity mechanisms. The juveniles adapted to 60 mg/L PO43--P by enhancing tissue repair activity in gill tissue via upregulation of Hedgehog and Wnt signaling pathways. Histological and molecular data indicated physiological damages and cell apoptosis in the gill tissue exposed to 120 mg/L PO43--P. Liver and spleen tissue damages were also observed in the 120 mg/L PO43--P group, and elevated levels of plasma alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase suggested potential impairments in both hepatic and immune functions. The oxidative stress responses, including upregulation of antioxidant genes and reduced enzyme activity, could be responsible for the damage of multiple tissues and systematic toxicity. These findings contribute new insights into the toxicity of PO43--P in fish and provide a theoretical basis for the necessity of PO43--P monitoring and removal technology research in marine aquaculture systems.
Authors: Lele Wu, Xin Li, Jiale Zhou, Ting Qi, Yaolin Li, Xiefa Song, Zongcheng Song, Xian Li
Full Source: Journal of environmental sciences (China) 2025 Oct:156:619-631. doi: 10.1016/j.jes.2024.10.005.

Understanding the role of endocrine disrupting chemicals as environmental obesogens in the obesity epidemic: A comprehensive overview of epidemiological studies between 2014 and 2024

2025-05-23
The prevalence of obesity has reached epidemic proportions worldwide, posing a significant public health concern due to its association with various chronic diseases and healthcare costs. In addition to traditional risk factors such as diet and physical activity, emerging evidence suggests that environmental pollutants, termed obesogens, may contribute to the obesity epidemic. Obesogens are endocrine-disrupting chemicals (EDCs) that can alter lipid homeostasis, promote adipogenesis, and disrupt metabolic regulation, leading to increased adiposity and obesity risk. This review explores available data from human studies published in the last decade, along with the mechanisms underlying obesogenic action, including their effects on adipocyte differentiation, adipose tissue development, and metabolic regulation. Overall, 75 studies were analyzed. Early-life exposure during critical developmental windows has been shown to increase obesity risk later in life, potentially through

epigenetic modifications and transgenerational effects. Epidemiological studies provide evidence of associations between prenatal or early-life exposure and increased obesity risk in offspring. Additionally, study found more consistent associations between exposure to some EDCs (including phthalates, parabens, and bisphenols) and obesity or metabolic outcomes in children and women, while results for other chemicals (i.e. PFAS and organochlorine pesticides) were more heterogeneous, especially in adolescents and adults. Key findings indicate consistent associations between phthalate exposure and obesity in children, with mixed results for adults. Future research should focus on elucidating the full spectrum of obesogens, their mechanisms of action, and their implications for obesity risk across generations. This knowledge will inform preventive strategies and public health interventions aimed at addressing the obesity epidemic and its associated health burden.

Authors: Marta Jaskulak, Malwina Zimowska, Marta Rolbiecka, Katarzyna Zorena

Full Source: Ecotoxicology and environmental safety 2025 May 23:299:118401. doi: 10.1016/j.ecoenv.2025.118401.

ENVIRONMENTAL RESEARCH

Untargeted metabolomics offers insights into the risks of chronic exposure to mixtures of polycyclic aromatic hydrocarbons at environmentally relevant low concentrations

2025-05-25

Polycyclic aromatic hydrocarbons (PAHs) often occur in mixtures, creating complex interactions in humans and other organisms exposed through food. However, the effects of these PAH mixtures at environmentally relevant low concentrations (ERC) on the metabolome have been underexplored. This research investigated the ERC of PAHs in Vembanad estuary biota and examined the impact of chronic exposure to these mixtures using an untargeted metabolomics approach. The study observed that 64% of the aquatic samples analysed from India's Ramsar site (VE) had been detected with one or more PAHs (ΣPAHs5.12-1015.28 ng/g). The non-carcinogenic risk from dietary PAH exposure was low, but cancer risk analysis showed a moderate to high risk for specific areas, particularly Perumbalam. Furthermore, the untargeted metabolomics study revealed that chronic exposure to a PAH mixture at ERC dysregulated metabolites from major classes, including phosphatidylcholines,

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amino acids, fatty acyls, bile acids, nucleotides, purines, pyrimidines, and vitamins. These metabolites are predominantly associated with key metabolic pathways, including mitochondrial electron transport, pyrimidine metabolism, the citric acid cycle, and butyrate metabolism, all of which play critical roles in cellular energy production, biosynthesis, and regulation. Pathway analysis revealed that long-term exposure to PAH mixtures, even at low doses, significantly affects phenylalanine, tyrosine, and tryptophan metabolism, increasing the likelihood of metabolic and endocrine disorders.

Authors: Nasreen Nazar, A S Athira, Ranjit Kumar Nadella, Satyen Kumar Panda, Kaushik Banerjee, Niladri Sekhar Chatterjee

Full Source: Environmental geochemistry and health 2025 May 25;47(6):227. doi: 10.1007/s10653-025-02547-0.

Occurrence and environmental risk assessment of pesticides reveal important threats to aquatic organisms in precordilleran rivers of north-central Chile

2025-05-23

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While pesticides are essential for food production, their widespread use poses environmental risks beyond lowland areas. Recent evidence indicates that mountain ecosystems are also vulnerable due to both local agriculture and long-range atmospheric transport. This study assesses pesticide contamination and ecological risks in five mountainous agricultural watersheds of north-central Chile, where pesticides support intensive crop production. Using primarily polar organic chemical integrative samplers (POCIS), complemented by sediment samples, we found pesticides at 26 of 30 sampled sites. Detection varied by location and method. Desethylatrazine, an atrazine metabolite, was most frequently found in POCIS samples, detected at 20 sites across all watersheds. While other pesticides only occurred at few sites, their presence across multiple, geographically dispersed locations contributed to extensive ecological risk. Northern watersheds (Limarí, Choapa, Aconcagua) showed the highest ecological risks, despite lower pesticide loads, due to the presence of highly toxic insecticides. Key factors influencing pesticide distribution included water conductivity, agricultural land use, and latitude. Ecotoxicological risk assessments revealed eight pesticides exceeding high-risk thresholds for aquatic organisms-mainly insecticides and fungicides. Pyrethroids such as deltamethrin, cyfluthrin, and lambda-cyhalothrin posed severe threats to fish and invertebrates. High-risk levels were also detected in sediments, particularly in the

undefined.

northernmost Limarí watershed. These findings underscore the urgent need for targeted monitoring and stricter pesticide regulation in mountain freshwater ecosystems of Chile, which are vital water sources and harbor unique biodiversity. This study provides one of the first comprehensive evaluations of pesticide risks in mountainous rivers, highlighting the ecological threats from agricultural contaminants.
Authors: Nicolas Gouin, Angéline Bertin, Daniel D Snow, Adriana Lozada, Frédéric Grandjean, Alan S Kolok
Full Source: The Science of the total environment 2025 May 23:984:179701. doi: 10.1016/j.scitotenv.2025.179701.

PHARMACEUTICAL/TOXICOLOGY

Molecular mechanistic approach to reveal decitabine's effect on DNMT gene modulation and its inhibitory role in heavy metal-induced proliferation in urinary bladder cancer cell line

2025-05-23
Heavy metals are pervasive environmental and occupational carcinogens known to induce cell proliferation. They influence a number of cellular processes, including proliferation, metabolism, apoptosis, and carcinogenesis. Among the several underlying mechanisms of carcinogenesis, metal-induced aberrant modulation of DNA methyltransferase (DNMT) activity may play crucial role. In this context, our study explored the proliferative and/or cytotoxic effects of heavy metals on the T24 urinary bladder cancer cell line. Additionally, it also evaluated effects of heavy metals and chemotherapeutic agent decitabine on DNMTs expression and activity. For investigation purpose, T24 cells were exposed to heavy metals; namely, lead (Pb), chromium (Cr), cadmium (Cd), nickel (Ni), and arsenic (As) at concentrations ranging from 0.5 to 32 µM for 24, 48, and 72 h, as well as decitabine (1 to 64 µM) for 72 h. Post-incubation, cell proliferation and migration increased, and mitochondrial membrane potential decreased significantly in the presence of heavy metals, especially Cr and Cd. Moreover, in the presence of Cr and Cd, expressions of DNMT1 and DNMT3b genes enhanced significantly. Furthermore, decitabine treatment effectively inhibited Cd- and Cr-induced proliferation and downregulated DNMT gene expression. In conclusion, heavy metals such as Cd and Cr may contribute to urinary bladder carcinogenesis through DNMT upregulation, while decitabine

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showed prominent protective effects by suppressing DNMT expression and inhibiting cell proliferation.
Authors: Deepika Saini, Pankaj Kumar Chaudhary, Ganesh Kumar Verma, Jitendra Kumar Chaudhary, Raman Kumar, Sarama Saha, Partha Roy, Bela Goyal, Ramasare Prasad, Anissa Atif Mirza-Shariff
Full Source: Toxicology in vitro: an international journal published in association with BIBRA 2025 May 23:106082. doi: 10.1016/j.tiv.2025.106082.

Immunosuppressive role of benzo[a]pyrene exposure in prostate cancer progression

2025-10
Epidemiological studies indicate that prostate cancer (PCa) is the second prevalent malignant tumor affecting men globally. Environmental pollution such as cigarette smoke is one of the important risk factors for the development of prostate cancer. However, as one of the main carcinogens in cigarette smoke, the role of benzo[a]pyrene (BaP) in prostate cancer is still unclear. The current study aimed to investgate the impacts of BaP exposure on the progression of PCa toward malignancy and the regulation of the immune microenvironment. We verified that BaP exposure can promote the proliferation, migration, and apoptosis of prostate cancer cells through in vitro experiments. We constructed a subcutaneous xenograft tumor model of BaP exposure mouse and found that can promote the proliferation of tumors in vivo. Organoids-driven by PCa patients showed higher growth rate under BaP exposure. Flow cytometric analysis demonstrated a remarkable decrease in CD4+ T and CD8+ T cell infiltration levels. Moreover, we identified four genes (Mdm2, Ar, Foxo1, Crebbp) were strongly associated with BaP exposure by combining mouse tumor RNA-seq and CTD database. Additionally, a nomogram integrating clinicopathological features was constructed to assess the prognosis of prostate cancer patients under BaP exposure. This study systematically proved that BaP exposure promotes malignant progression of PCa and suppresses the immune microenvironment, in which Mdm2, Ar, Foxo1, Crebbp may play a crucial role in inhibiting apoptosis. These findings offer novel insights into the mechanisms via which BaP exposure contributes to PCa development.
Authors: Zhijin Zhang, Wentao Zhang, Huan Wang, Haotian Chen, Hong Wang, Yang Yu, Danjing Shen, Man Pi, Yang Wu, Ming Luo, Yanyan He,

Shiyu Mao, Jiang Geng, Wei Li, Guangchun Wang, Changcheng Guo, Daqiang Yin, Xudong Yao
Full Source: Journal of environmental sciences (China) 2025 Oct:156:185-199. doi: 10.1016/j.jes.2024.11.032.

OCCUPATIONAL

Neonatal exposure to phthalates and their alternatives and associated thyroid disorders: Levels, potential health risks, and mechanisms

2025-10
The number of newborns born with diseases is increasing recently. Thyroid hormones (THs) are closely related to the growth and development of the newborn in the mother's womb and to the carriage of related diseases after birth. Environmental endocrine-disrupting compounds (EDCs) have been proven to harm THs in newborns. Phthalates (PAEs), a typical class of EDCs, are commonly used in toys, childcare materials, and food contact materials, which have been closely connected with neonatal thyroid dysfunction and thyroid-related diseases. As restrictions on PAEs become more stringent in neonatal field, numerous PAE alternatives are emerging. Associations between exposure to PAEs and their alternatives and dysfunctions in THs have been explored. Hence, we summarized the body burdens and regional characteristics of PAEs and their alternatives in neonatal urine, cord blood, and meconium. Subsequently, the influences of PAEs and their alternatives on thyroid dysfunction, prematurity, low birth weight, fetal growth restriction, respiratory dysfunction, immune disorders, neurological disorders, and reproductive disorders in newborns were evaluated. Furthermore, we scrutinized the effects of PAEs and their alternatives on the neonatal thyroid from signaling, substance transport, and hormone production to explore the underlying mechanisms of action on neonatal thyroid and thyroid-related disorders. As the declining global trends of healthy newborns and the potential impacts of PAEs and their alternatives on thyroid function, a more comprehensive study is needed to discuss their effects on newborns and their underlying mechanisms. This review facilitates attention to the effects of PAEs and their alternatives on thyroid and thyroid-related disorders in newborns.
Authors: Yuting Chen, Xueyu Weng, Yu Hu, Jia Yin, Shuang Liu, Qingqing Zhu, Ligang Hu, Chunyang Liao, Guibin Jiang
Full Source: Journal of environmental sciences (China) 2025 Oct:156:519-538. doi: 10.1016/j.jes.2024.10.026.

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Using hair as a non-invasive matrix to assess the exposure of e-waste workers to selected heavy metals in Pakistan

2025-05-25
Pakistan has become a significant recipient of e-waste, largely due to lower labor costs, lack of local environmental regulations, and less stringent international controls. Limited research exists on e-waste generation, management, and pollution in Pakistan. This study aimed to analyze levels of selected heavy metals in human hair samples from workers at informal e-waste processing facilities in six major cities: Karachi, Lahore, Rawalpindi, Faisalabad, Gujranwala, and Peshawar. A total of 150 hair samples were collected from workers aged 15 to 60 years and compared with samples from a control group of individuals who had no exposure to e-waste processing for at least the previous five years. Results revealed higher average concentrations (μg/kg) of Zn (577) in the hair of e-waste facility workers, followed by Fe (534), Al (265), and Cu (105). Significant age-related differences were observed for Zn, Fe, Cd, and Pb ($p < 0.01$), indicating these metals are prevalent during e-waste recycling. Notably, Fe, Zn, and Al concentrations were significantly higher in the 56 + age group, suggesting prolonged exposure. Strong correlations ($p < 0.01$) were found between pairs such as Al-Cu, Al-Fe, Zn-Cu, and Cd-Pb, which can serve as markers of high exposure due to prolonged e-waste recycling activities. In conclusion, hair analysis is a noninvasive, cost-effective method to provide preliminary information on heavy metal exposure in both control and exposed groups. Further studies are recommended to evaluate the correlation between heavy metals in hair, urine, and blood samples of informal e-waste recyclers to establish exposure routes and adverse health effects on metabolic activities.
Authors: Sumaira Akram, Said Akbar Khan, Hatice Kubra Gul, Jabir Hussain Syed, Mureed Kazim, Syed Aziz Ur Rehman, Mustafa Odabasi, Perihan Kurt-Karakus
Full Source: Environmental geochemistry and health 2025 May 25;47(6):226. doi: 10.1007/s10653-025-02528-3.

Developmental exposure to echimidine induces locomotor hyperactivity in zebrafish larvae via inhibiting acetylcholinesterase activity

2025-10
Pyrrolizidine alkaloids (PAs) are natural toxins generated as secondary metabolites in plants, predominantly consisting of unsaturated PAs with diverse toxicities, such as hepatotoxicity. Echimidine, a prominent

PA, is believed to exert various toxicological effects, including survival inhibition and induction of apoptosis of hepatocytes. However, the effects of echimidine on development remain unclear. We selected three concentrations of 0.02, 0.2, and 2 mg/L to investigate the developmental toxicity of echimidine on zebrafish embryos. After a 7-day exposure, we observed hyperactivity and anxiety-like behavior in zebrafish larvae. Furthermore, we found that echimidine exposure significantly promoted embryonic motor neurodevelopment in genetically modified zebrafish. Next, we detected that echimidine exposure significantly increased the content of the excitatory neurotransmitter acetylcholine (ACh), accompanied by a significant decrease in acetylcholinesterase (AChE) activity. Conversely, echimidine led to a significant reduction in the content of the sedative neurotransmitter γ-aminobutyric acid (GABA), accompanied by abnormal gene expression of enzymes related to GABA synthesis. Moreover, we elucidated the strong direct binding of echimidine to zebrafish and human AChE protein through molecular docking. In summary, our study found that echimidine induced ACh accumulation possibly by inhibiting AChE activity, leading to motor neurodevelopmental abnormalities and hyperactivity in zebrafish larvae. This work provides important scientific knowledge on the effects and mechanisms of PAs on neural development, which is helpful for controlling the risk of PAs in food and protecting public health.

Authors: Tingting Lin, Siyu Chen, Yingyi Ren, Junyu Liang, Zhenghong Zuo, Zhiqiang Luo, Jian Yang, Chengyong He

Full Source: Journal of environmental sciences (China) 2025 Oct:156:882-893. doi: 10.1016/j.jes.2024.12.036.