

CHEMWATCH

# TECHNICAL

Week of 20 March 2026

---

TECHNICAL

# CONTENTS

---

## TECHNICAL

---

### OCCUPATIONAL

Pesticide Residues in Apples and Pears: A Deterministic Assessment of Chronic Exposure and Non-Carcinogenic Risk for European Consumers

Assessment of hydrogen sulfide exposure in shoreline cleanup workers during the 2025 Atlantic Sargassum bloom

### CHEMICAL EFFECTS

DNA methylation mediates the association between organochlorine pesticides and MASLD: An epigenome-wide association study with integrated AOP framework

Early-life exposure to per- and polyfluoroalkyl substances and heavy metals and lower lung function in school-age children: A prospective cohort study

### ENVIRONMENTAL RESEARCH

Subchronic, Low-Frequency Polystyrene Microplastic or Nanoplastic Exposure Elicits Molecular Perturbations but Minimal Clinical Phenotypes in the Mouse Gut-Brain Axis

An integrated review of glyphosate ecotoxicity and environmental fate in aquatic systems using species sensitivity distributions and meta-analysis

Polybrominated diphenyl ethers (PBDEs) contaminations across environmental compartments in the Middle East and North Africa

### PHARMACEUTICAL/TOXICOLOGY

Hepatotoxicity of environmental acetamiprid and cadmium in *Pelophylax nigromaculatus*: An integrated analysis from histopathology to molecular mechanisms

Experimental and computational studies of transformation of sulfachloropyridazine during water chloramination: Kinetics, mechanism and toxicity

A Weight of Evidence Evaluation on the Immunosuppressive Potential of Xylene

# TECHNICAL

## OCCUPATIONAL

### **Pesticide Residues in Apples and Pears: A Deterministic Assessment of Chronic Exposure and Non-Carcinogenic Risk for European Consumers**

Molecules (Basel, Switzerland) 2026 Feb 25;31(5) · 25 Feb 2026

(1) Pome fruits (apples and pears) are among the most frequently consumed fruits in Europe and may contribute to dietary exposure to pesticide residues. Although residue levels generally comply with maximum residue limits (MRLs), even low concentrations may cumulatively contribute to chronic health risks under conditions of frequent and long-term consumption. This study aimed to quantitatively assess dietary exposure and the potential non-carcinogenic health risks associated with pesticide residues in apples and pears, using representative monitoring and consumption data. (2) The assessment was based on results of the Polish national official monitoring program for pesticide residues in food, specifically apples and pears sampled in 2022, as reported by the National Institute of Public Health (NIZP-PZH). These data were combined with age- and body weight-specific consumption scenarios derived from FAO/WHO GEMS/Food cluster diets and national Polish statistics. For the most frequently detected pesticides (captan, flonicamid, acetamiprid and fosetyl-Al in apples; captan and acetamiprid in pears), the mean and 95th percentile concentrations were used to estimate the estimated daily intake (EDI). Non-carcinogenic risk was characterized using the hazard quotient ( $HQ = EDI/ADI$ ) and the cumulative Hazard Index (HI). The hazard quotient (HQ) was calculated as the ratio of estimated daily intake to the acceptable daily intake ( $HQ = EDI/ADI$ ), while the Hazard Index (HI) was defined as the sum of individual HQ values for pesticides detected in a given commodity and exposure scenario ( $HI = \sum HQ$ ). Calculations were performed separately for children and adults under several dietary scenarios (Polish general population, German child, German general population, GEMS/Food G08). (3) For all pesticides and exposure scenarios, the HQ values were well below 1, indicating no exceedance of the acceptable daily intake (ADI). The highest chronic exposure was observed for apples in children (German child scenario), with the HQ values for captan, flonicamid and acetamiprid in the approximate range of 0.01-0.05, while the HI remained  $< 0.1$  even under high-consumption conditions. In adults (Polish and German general populations, GEMS/Food G08), HQ values were approximately one order of magnitude lower than in children, and the cumulative HI values for both apples and pears were far below 1. The contribution of pears to total exposure was limited, reflecting lower consumption and fewer active substances detected. (4) This quantitative risk assessment, based on Polish monitoring data from 2022, indicates that under current residue levels and consumption patterns, chronic dietary exposure to pesticide residues from apples and pears does not pose a relevant non-carcinogenic health concern for either children or adults. Nevertheless, children consistently showed higher relative exposure than adults, underscoring the importance of age-stratified risk assessment and continued monitoring of residues in commonly consumed fruits. The findings

support existing regulatory frameworks while justifying sustained, targeted surveillance of key active substances in pome fruits as part of public health prevention strategies.

[Read More →](#)

## Assessment of hydrogen sulfide exposure in shoreline cleanup workers during the 2025 Atlantic Sargassum bloom

Harmful algae 2026 Apr:154:103092 · 1 Apr 2026

Since 2011, massive blooms of pelagic Sargassum spp. have emerged as a recurrent environmental crisis across the tropical Atlantic. Along affected coastlines, thousands of tons can accumulate annually, releasing toxic gases during anaerobic decomposition and posing potential health risks. Hydrogen sulfide (H<sub>2</sub>S) is of concern due to its adverse effects on the respiratory, neurological, gastrointestinal, and ocular systems. This study quantified H<sub>2</sub>S exposure among Sargassum cleanup workers in the Mexican Caribbean during the unprecedented 2025 bloom, the largest recorded to date. 35 workers were equipped with a portable personal sensor (1 ppm resolution; 1-100 ppm detection range) that recorded H<sub>2</sub>S concentration at 1 s intervals throughout Sargassum removal activities. H<sub>2</sub>S concentrations ranged from <1 to 50.8 ppm. Overall, 46.3% of readings exceeded the Mexican occupational standard of 1 ppm for an 8 h shift, 1.7% exceeded 10 ppm, and short-term spikes surpassed 50 ppm. Questionnaire data indicated that workers reported dermatological, respiratory, neurological, ocular, and gastrointestinal symptoms consistent with known H<sub>2</sub>S toxicodynamics, suggesting acute health impacts even at concentrations below <5 ppm. These findings support adopting a permissible exposure limit (PEL) of ≤1 ppm (8 h time-weighted average) and a short-term exposure limit (STEL) of 5 ppm (15 min), in line with Mexican and ACGIH safety standards. This study provides the first direct evidence of acute H<sub>2</sub>S exposure among Sargassum cleanup workers and highlights the urgent need for continuous monitoring, protective equipment, and strengthened occupational safety measures in regions affected by massive Sargassum strandings.

[Read More →](#)

### CHEMICAL EFFECTS

## DNA methylation mediates the association between organochlorine pesticides and MASLD: An epigenome-wide association study with integrated AOP framework

Journal of hazardous materials 2026 Mar 09:507:141727 · 9 Mar 2026

Chronic exposure to organochlorine pesticides (OCPs) is associated with altered DNA methylation and metabolic diseases, but their specific methylation patterns and mediating role in metabolic dysfunction-associated steatotic liver disease (MASLD) remain unclear. We conducted an epigenome-wide association study among 2905 adults, measuring 19 serum OCPs and blood DNA methylation using the Illumina EPIC array. Differentially methylated probes (DMPs) were identified via linear regression, and mediation analyses assessed their mediating effects on MASLD. We also constructed an integrated adverse outcome pathway (AOP) network to illustrate the underlying mechanisms. Eighteen novel OCP-associated DMPs were identified, of which 11 DMPs were related to prevalent MASLD and four to incident MASLD, with three overlapping (cg17075888, cg27402362,

and cg11024682). In the cross-sectional analysis, eight DMPs (e.g., ABCG1, CPT1A, SREBF1) statistically mediated 15.90% of the association between  $\beta$ -HCH and prevalent MASLD. Furthermore, the longitudinal analysis provided stronger evidence, suggesting that cg27402362 (RUNX3) mediated 5.22% of the  $\beta$ -HCH and incident MASLD association. The AOP network included six molecular initiating events and 19 key events, implicating lipid metabolism, oxidative stress, and immune and inflammatory pathways. This study provides novel population-based evidence that OCP exposure may be associated with MASLD development through DNA methylation mechanisms. The AOP framework further strengthens the mechanistic plausibility of OCP-induced hepatotoxicity and improves our understanding of OCP-associated MASLD.

[Read More →](#)

## Early-life exposure to per- and polyfluoroalkyl substances and heavy metals and lower lung function in school-age children: A prospective cohort study

Environmental research 2026 Mar 12:298:124277 · 12 Mar 2026

Previous studies examining the associations of per- and polyfluoroalkyl substances (PFAS) and heavy metals (HMs) with lung function have yielded inconsistent findings. We investigated the associations of PFAS and HMs with lung function in a Korean birth cohort followed up to 10 years of age. Data from the Environment and Development of Children (EDC) cohort were used (n = 505). Serum PFAS and whole blood HM concentrations were measured at ages 2, 4, and 6 years. Lung function was assessed at ages 8 and 10 years. Linear mixed models were used to evaluate the associations of individual chemicals with repeated lung function measurements. Principal component analysis (PCA) within a doubly robust estimation framework was applied to examine the associations between chemical mixtures and lung function. In analyses for individual chemicals, several PFAS (e.g., perfluorooctanoic acid [PFOA] and linear perfluorooctane sulfonate [L-PFOS]) and HMs (e.g., mercury and cadmium), particularly those measured at age 2, were associated with lower lung function. In mixture analyses, higher age-2 PCA-derived exposure patterns characterized by PFAS-dominant components were associated with lower FEF25-75 [ $\beta$  = 0.04, 95% confidence interval (CI): 0.01, 0.07], whereas higher age-2 HM-dominant components were associated with lower FEV1/FVC ( $\beta$  = 1.33, 95% CI: 0.63, 2.03) at 8-10 years. These findings suggest that early-life exposure to PFAS- and HM-dominant mixtures, particularly around age 2 years, may adversely influence subsequent lung function. Our results highlight the importance of early-life prevention strategies to minimize exposure to these ubiquitous chemicals, particularly around 2 years of age.

[Read More →](#)

### ENVIRONMENTAL RESEARCH

## Subchronic, Low-Frequency Polystyrene Microplastic or Nanoplastic Exposure Elicits Molecular Perturbations but Minimal Clinical Phenotypes in the Mouse Gut-Brain Axis

Environmental pollution (Barking, Essex : 1987) 2026 Mar 12:397:127957 · 12 Mar 2026

The global public concerns about micro- and nanoplastics (MNPs) are on the rise, whereas the mechanisms underlying MNP-mediated toxicity have not been fully elucidated. In particular, toxic responses in the gut-brain axis of mice varied across studies due to the high variability in

experimental exposure designs. Thus, we employed a mouse model (n = 46) with a standardized exposure regimen of 0.3 mg per treatment, administered twice weekly for 12 consecutive weeks, to systematically evaluate MP (5  $\mu\text{m}$ ) and NP (0.5  $\mu\text{m}$ ) induced toxicity in both the gut and the brain. In the mouse brain, 5  $\mu\text{m}$  MP exposure significantly depleted serotonin levels, whereas both MNP sizes induced a compensatory elevation in SOD activity and substantial dysregulation of pro-inflammatory cytokines. Notably, these biochemical alterations occurred without a distinct corresponding shift in behavioral or histopathological profiles. Our results also highlighted that exposure frequency may be a key determinant of MNP-induced toxicity, suggesting a potential need for risk assessment of MNP in humans.

[Read More →](#)

## **An integrated review of glyphosate ecotoxicity and environmental fate in aquatic systems using species sensitivity distributions and meta-analysis**

Pesticide biochemistry and physiology 2026 Apr:219:107025 · 1 Apr 2026

The intensive global application of glyphosate has led to widespread contamination of aquatic environments, raising significant concerns for non-target organisms. This review systematically synthesizes and quantifies the environmental fate of glyphosate in aquatic systems, encompassing its transport, degradation, bioaccumulation, and ecotoxicological effects across various species. A distinctive feature of our analysis is the integration of meta-analysis and species sensitivity distribution (SSD) modeling to quantitatively derive toxicity thresholds and identify the most sensitive taxonomic groups. Meta-analysis of acute toxicity data reveals a distinct, concentration-dependent hierarchy of sensitivity (aquatic plants > fish > invertebrates > amphibians), which aligns with the plant-targeted mode of action of herbicide. SSD-derived chronic hazard concentrations (HC5) fall within the sub-milligram-per-liter range and indicate that invertebrates can exhibit equal or greater long-term sensitivity compared to aquatic plants. The primary toxic mechanisms are identified as oxidative stress, enzymatic inhibition, and endocrine disruption, culminating in neurological, developmental, and reproductive impairments across taxa. Commercial formulations are consistently shown to be significantly more toxic than glyphosate alone, and it is attributed to surfactant co-formulants. Furthermore, environmental factors such as pH, temperature, and water hardness are identified as key modulators of toxicity and environmental behavior of glyphosate. Critical knowledge gaps persist, particularly concerning the chronic effects of low-level exposures, the combined toxicity of mixtures of glyphosate and other complex pollutants, and its transformation and migration dynamics at the sediment-water interface. Addressing these uncertainties is paramount for refining ecological risk assessment frameworks and developing effective management strategies to mitigate the impacts of glyphosate in aquatic ecosystems.

[Read More →](#)

## **Polybrominated diphenyl ethers (PBDEs) contaminations across environmental compartments in the Middle East and North Africa**

Environmental research 2026 Mar 12:298:124264 · 12 Mar 2026

Polybrominated diphenyl ethers (PBDEs) are persistent brominated flame retardants that migrate from treated products into environmental media and indoor reservoirs, creating long-term exposure concerns. We systematically reviewed PBDE contamination across environmental compartments in

the Middle East and North Africa (MENA). The protocol was registered prospectively in PROSPERO (CRD420251207298). Following PRISMA guidance, PubMed, Scopus, and Web of Science were searched for English-language studies without date restrictions through November 2025. Thirty-Eight studies were included. Across MENA, PBDE occurrence was heterogeneous and strongly matrix- and location-dependent. Türkiye consistently reported the highest concentrations and the greatest evidence base, with recurring hotspots in industrialized and urban settings, whereas remote/coastal background locations generally showed low levels. Congener patterns were consistent across compartments: BDE-209 dominated soils and sediments, supporting the role of particle-rich media as long-term sinks linked to historical deca-BDE use and deposition processes. Indoor air and dust more frequently showed higher relative contributions of lower-brominated congeners (notably BDE-47 and BDE-99), consistent with emissions from consumer products and dust-mediated exposure pathways. Sediment cores provided additional evidence of temporal variability and legacy inputs in parts of the region. Risk-of-bias appraisal indicated broadly adequate reporting of study setting and outcomes, but frequent limitations in sample size justification and incomplete reporting of potential biases. Overall, PBDE contamination in MENA reflects combined influences of industrial activity, urban infrastructure, indoor reservoirs, and episodic atmospheric transport. Harmonized monitoring, improved reporting standards, and targeted hotspot and indoor exposure assessments are priorities for the region.

[Read More →](#)

## PHARMACEUTICAL/TOXICOLOGY

### **Hepatotoxicity of environmental acetamiprid and cadmium in *Pelophylax nigromaculatus*: An integrated analysis from histopathology to molecular mechanisms**

Pesticide biochemistry and physiology 2026 Apr:219:106984 · 1 Apr 2026

In agricultural ecosystems, pesticides and heavy metals often coexist as understudied threats to ecological health. Although traditional risk assessments focus on single contaminants, the combined effects, particularly on ecologically relevant amphibians such as *Pelophylax nigromaculatus*, remain poorly understood. Among these pollutants, the neonicotinoid acetamiprid and cadmium are widely detected in aquatic environments, yet their combined hepatotoxicity in adult amphibians has not been adequately investigated. In this study, we aimed to investigate the individual and combined toxic effects of acetamiprid and cadmium in *P. nigromaculatus* at environmentally relevant concentrations, employing an integrated multi-omics approach in conjunction with biochemical and histopathological evaluations. Individual exposures induced significant metabolic disruption and tissue injury. In contrast, co-exposure triggered a unique adaptive compensation network that maintained redox balance and redirected amino acid and nucleotide metabolism, thereby mitigating inflammatory activation and liver damage. Molecular docking simulations further revealed differential binding interactions of acetamiprid and an acetamiprid-cadmium complex with key compensatory proteins, providing a mechanistic basis for the attenuated toxicity under combined exposures. These results highlight the importance of incorporating mixture toxicity and life-stage-specific responses into ecological risk assessments, reveal unexpected adaptive pathways in amphibians exposed to complex pollutant scenarios, and emphasize the need for more comprehensive evaluations of interactions among environmental contaminants.

[Read More →](#)

## Experimental and computational studies of transformation of sulfachloropyridazine during water chloramination: Kinetics, mechanism and toxicity

Journal of hazardous materials 2026 Mar 12:507:141748 · 12 Mar 2026

Sulfachloropyridazine (SCP), a widely used broad-spectrum antibiotic, occurs in surface water and it can react with chloramine during disinfection to produce new disinfection by-products (DBPs). This study presents the first comprehensive investigation into the kinetics, transformation mechanisms, and toxicological implications of SCP-derived DBPs during chloramine treatment. Our findings unveil the chloramination of SCP follows pseudo-second-order reaction kinetics, with pH critically modulating reaction pathways: lower pH values strengthen the hydrolysis of chloramine and enhance chlorination potential to promote the conversion of neutral SCP (pH 6.0,  $k_{obs} = 1.13 \times 10^{-2} \mu\text{mol}^{-1}\text{h}^{-1}$  vs. pH 8.0,  $k_{obs} = 3.89 \times 10^{-4} \mu\text{mol}^{-1}\text{h}^{-1}$ ), accelerating DBP formation and diversifying their structural profiles. Accelerating DBP formation and diversifying their structural profiles. Notably, eight previously unreported nitrogen-containing DBPs are identified, expanding the known chemical space of antibiotic-derived DBPs. Theoretical simulation further illustrates three transformation pathways, including chlorine substitution, hydroxyl substitution, and desulfurization, and provides the molecular-level explanation for the heightened reactivity of neutral SCP versus its anionic form. Furthermore, in vitro toxicity assays demonstrate that SCP transformation products decrease Hep G2 cell viability by 31.6%, revealing previously unrecognized cytotoxic risks that substantially exceed those of the parent compound. By integrating kinetic, mechanistic, and toxicological evidence, this work not only discerns the fate of SCP during chloramine disinfection but also establishes a paradigm for assessing hidden health and environmental risks posed by pharmaceutical-derived DBPs.

[Read More →](#)

## A Weight of Evidence Evaluation on the Immunosuppressive Potential of Xylene

Regulatory toxicology and pharmacology : RTP 2026 Mar 12 · 12 Mar 2026

Xylene substances (xylene) are high production chemicals that are currently undergoing new data generation and dossier evaluation under European Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) including consideration of an additional immunotoxicity testing cohort to an extended one-generation reproduction toxicity study (EOGRTS). To address the need for an additional EOGRTS cohort, a weight of evidence assessment was conducted on xylene's immunosuppression potential using ToxRTool, and the World Health Organization (WHO) International Programme on Chemical Safety (IPCS) framework. The evaluation included a review of historical human and experimental animal literature as well as new toxicity data from guideline studies. Two limited epidemiology studies showed no xylene exposure-related effects on white blood cell counts. Reliable study results from a mouse host resistance model were negative. No mammalian T-cell dependent antibody response assays were located for xylene in the literature review. No xylene-related immunological change was observed in an avian immunotoxicity study. In addition, a review of immune functional data on structural analogues did not indicate a signal for immunosuppression. Lastly, in guideline studies, several statistically spurious, isolated,

and/or inconsistent immune system findings were observed, but overall, the dataset in its totality demonstrated no signal of xylene-mediated immunosuppression. In conclusion, xylene shows no evidence of immunosuppression and there is no need for an immunotoxicity cohort evaluation in any subsequent EOGRTS.

[Read More →](#)