

8. HEALTH EFFECTS: WHAT DO WE REALLY KNOW?

The halogenated organic compounds examined in this section have very different properties and toxicological profiles. Some persist in the environment and accumulate in organisms; others are volatile and eliminated more rapidly; still others form during food processing. The presence of chlorine or bromine alone is not an indicator of harmfulness. Understanding health effects requires assessment of individual substances or well-defined mixtures, dose, duration and exposure routes.

FROM HAZARD TO RISK: TWO DIFFERENT CONCEPTS

Hazard is a substance's inherent ability to cause harm under certain conditions. Risk instead concerns the probability and severity of that harm under actual exposure conditions. Identifying a compound as carcinogenic, neurotoxic or harmful to the kidneys does not mean that any trace in food causes the corresponding disease. Equally, compliance with a legal requirement does not prove that risk is exactly zero.

Toxicological assessments use human evidence where adequate and experimental studies, often at doses higher than dietary exposures. Scientific authorities account for interspecies differences, individual variability and data gaps. Assessments may consequently establish a tolerable intake or use a margin of exposure (MOE): a comparison between a toxicological reference point and estimated exposure. The MOE must be interpreted according to criteria for the particular substance; no universal threshold applies to all contaminants.

CHLORINATED PARAFFINS: TARGET ORGANS AND UNCERTAINTIES

EFSA's 2020 assessment of short-, medium- and long-chain chlorinated paraffins (SCCPs, MCCPs and LCCPs) reviewed animal studies showing effects on the liver, kidneys and thyroid for certain mixtures. Developmental effects in offspring were also observed for some MCCPs under particular experimental conditions. Such findings cannot automatically be assigned to the thousands of possible molecules in commercial mixtures.

EFSA did not consider it appropriate to establish a health-based guidance value for these families because of substantial toxicological uncertainties. A preliminary assessment based solely on exposure through selected fish did not indicate a health concern in the scenario examined. That finding cannot, however, be generalised to the entire diet: adequate data on many foods and LCCPs were lacking. The absence of a complete assessment proves neither harmlessness nor a concrete hazard from every consumption event.

BROMINATED FLAME RETARDANTS: DISTINCT ASSESSMENTS

In 2024, EFSA updated its dietary risk assessment for polybrominated diphenyl ethers (PBDEs), concluding that current dietary exposure in Europe is likely to raise a health concern. The relevant effects primarily involve nervous-system development and reproduction. Different congeners, data uncertainties and possible contributions from non-dietary exposure routes must nevertheless be distinguished.

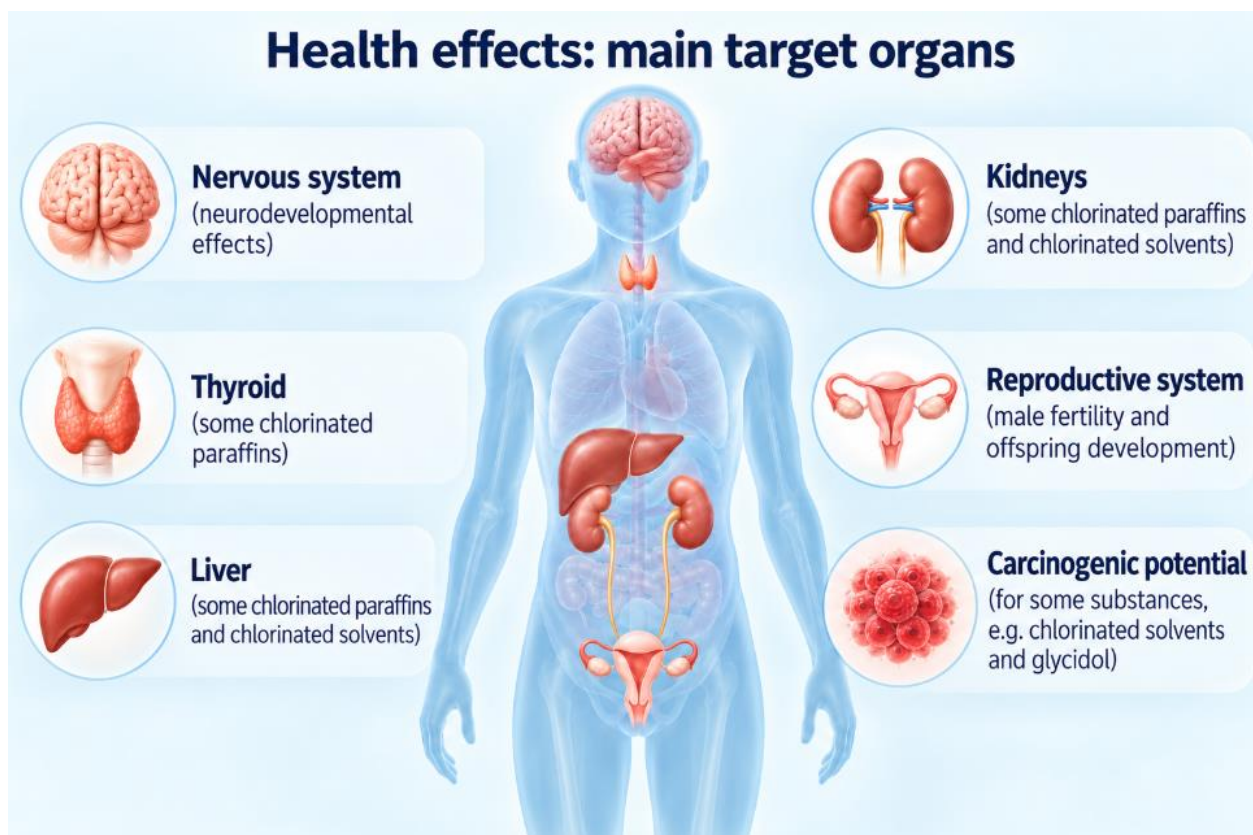
EFSA's 2021 assessment of hexabromocyclododecanes (HBCDDs) reached a different conclusion: estimated dietary exposure levels generally did not raise a concern for European populations. A possible concern was identified for certain breastfed infants with high milk consumption in a scenario still characterised by uncertainties. This does not constitute advice to stop breastfeeding, whose well-established benefits should remain separate from the discussion of contaminants.

EFSA's July 2026 assessment of emerging brominated flame retardants highlighted further knowledge gaps: data were insufficient for risk characterisation of many compounds. Where assessment was possible, the examined dietary exposures to BEH-TEBP, EH-TBB and DBDPE did not raise a health concern. Again, the conclusion concerns the substances and scenarios evaluated, not the entire flame-retardant family.

CHLORINATED SOLVENTS: EFFECTS AND EXPOSURE ROUTES

For certain chlorinated solvents, most epidemiological evidence comes from occupational or environmental exposures, not habitual food ingestion. IARC classifies trichloroethylene as carcinogenic to humans (Group 1), particularly on evidence concerning kidney cancer, and tetrachloroethylene as probably carcinogenic to humans (Group 2A). These are hazard classifications and do not quantify risk from a specific food concentration.

Depending on the substance and exposure, non-cancer effects may involve the central nervous system, liver and kidneys. Their volatility and metabolism make it inappropriate to describe these solvents indiscriminately as persistent, bioaccumulative pollutants. At contaminated sites, water used for drinking or food production may be an important exposure pathway; the extent of transfer into finished products must be established case by case.



CHLOROPROPANOLS: THE ROLE OF INDUSTRIAL PROCESSING

3-Monochloropropane-1,2-diol (3-MCPD) and its esters may occur in refined oils and various processed foods. In EFSA's updated 2018 assessment, renal effects were critical for 3-MCPD; EFSA established a group tolerable daily intake of 2 micrograms per kilogram of body weight per day for 3-MCPD and its esters, expressed as 3-MCPD. This value concerns repeated exposure over time, not a concentration limit applicable to every food.

The toxicological picture for 2-MCPD is less complete, and conclusions about 3-MCPD cannot simply be transferred to its isomer. Glycidyl esters are often studied alongside chloropropanols because they form under similar processing conditions, but they contain no halogens and are not members of the family addressed here.

CHILDREN, DEVELOPMENT AND INDIVIDUAL SUSCEPTIBILITY

Susceptibility may change across stages of life. Infants and children may have higher intakes per kilogram of body weight and developing organs; the magnitude and relevance of these differences depend on the contaminant. EFSA assessments consider

different age groups and consumption scenarios where data allow. It would be incorrect to claim that all halogenated organic compounds inevitably harm development.

CHEMICAL MIXTURES AND KNOWLEDGE GAPS

Food may contain several contaminants at the same time, but co-occurrence alone does not establish a synergistic effect. Combined toxicity depends on dose, mechanism of action, timing and demonstrated interactions. Cumulative assessment may be appropriate when substances act in similar ways, but reliable quantitative mixture-risk assessment is still hampered by insufficient data for many halogenated families.

An important practical limitation is analytical coverage: laboratories measure only the substances included in a method and only within its sensitivity and reliability. A 'not detected' result does not establish complete absence. Human biomonitoring, where available, documents internal exposure but does not automatically diagnose harm.

WHAT CAN THE READER CONCLUDE?

Scientific evidence identifies specific effects and concerns, but does not justify one judgement about all halogenated organic compounds. European assessments have identified potential health concerns regarding dietary PBDE exposure, whereas HBCDD exposure has generally led to reassuring conclusions with special caution for some infants. For chlorinated paraffins, data remain insufficient to characterise dietary exposure comprehensively. The most useful response is to reduce emissions, improve evidence, apply targeted food controls and interpret measurements in the light of toxicological knowledge. The next chapter examines these controls and the legal requirements that apply.

SCIENTIFIC AND REGULATORY REFERENCES

[EFSA CONTAM Panel \(2020\). Risk assessment of chlorinated paraffins in feed and food. EFSA Journal 18\(3\):5991.](#)

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[EFSA CONTAM Panel \(2026\). Update of the risk assessment on emerging and novel brominated flame retardants in food. EFSA Journal 24\(7\):10187.](#)

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