

7. WHICH FOODS MAY CONTAIN HALOGENATED ORGANIC COMPOUNDS, AND WHY?

The term 'halogenated organic compounds' covers widely differing substances. There can therefore be no single ranking of the 'most contaminated' foods: fish, meat, milk, oils and processed products may be affected by different contaminants through different pathways. In some cases, sufficient European data exist to estimate exposure; in others, measurements remain too sparse to provide a representative picture.

FISH AND SEAFOOD: AN IMPORTANT AREA OF STUDY

For persistent and lipophilic organohalogen substances, aquatic ecosystems are important transfer routes. Some of these contaminants bind to sediments, enter aquatic organisms and reach fish and other seafood. The process depends on species, geographical origin, lipid content, organism age and the properties of the individual substance: merely distinguishing marine from freshwater fish is insufficient.

In EFSA's 2020 assessment of chlorinated paraffins, the occurrence data suitable for dietary exposure estimates came mainly from selected fish samples. SCCPs and MCCPs were detected, but data could not represent the entire European diet and adequate LCCP data were unavailable. Fish is therefore a documented matrix, not proof that it is always the main exposure source for all chlorinated paraffins.

Fish also contributes to dietary exposure to some brominated flame retardants. In EFSA's 2021 opinion on HBCDDs, fish was among the main contributors to chronic exposure, alongside eggs and meat. This pattern cannot automatically be generalised to all brominated substances.

MEAT, EGGS, MILK AND ANIMAL FATS

For persistent contaminants with an affinity for lipids, transfer through feed, farm environments and the food chain may be particularly relevant. Occurrence in eggs, meat, milk and animal fats is documented for various brominated flame retardant families. European exposure estimates must nonetheless account for both concentration and actual consumption: a food with modest levels may contribute substantially to total exposure if it is eaten frequently.

HBCDDs provide an instructive example. EFSA identified fish, eggs, meat from farm animals and poultry among the main contributors to estimates based on measured concentrations. However, the health-concern conclusions for HBCDDs differ from those for PBDEs. EFSA's 2024 PBDE opinion updated the assessment of specific congeners and identified dietary exposure concerns. Each substance must therefore be considered separately.

VEGETABLE OILS AND FATS: TWO TYPES OF CONTAMINATION THAT MUST NOT BE CONFUSED

Oils may be tested for lipophilic environmental contaminants, but a distinct issue is the formation of chloropropanols during certain industrial treatments. 3-MCPD and its esters can form, particularly during high-temperature refining of oils and fats, depending on the raw materials and processing parameters. This does not mean that every refined oil contains high levels.

European legislation sets maximum levels for the sum of 3-MCPD and its esters, expressed as 3-MCPD, in certain categories of oils, fats and foods. Regulation (EU) 2023/915 distinguishes several categories, with specific provisions for foods intended for infants and young children. A single limit cannot correctly be applied to every oil or processed product.

Foods that can contain them



Refined vegetable oils and fats



Bakery products and snacks



Margarines and other processed foods



Infant formulas and baby foods



Soy sauces (acid hydrolysis)



Hydrolysed vegetable proteins

PROCESSED FOODS AND COMPOSITE INGREDIENTS

Processed foods may incorporate ingredients containing contaminants already present in raw materials, or develop processing contaminants during manufacture. Bakery products, snacks and composite preparations may receive some 3-MCPD and its esters from the oils used, but the concentration in the finished product depends on formulation, production technology and any subsequent transformations.

For some other chlorinated substances, such as certain industrial solvents, food contamination is more often associated with particular circumstances — contaminated water, facilities, accidents or non-compliant practices — rather than an even distribution across the food market. Their volatility and chemical properties make it inappropriate to describe them using the same bioaccumulation model as persistent organic pollutants.

VEGETABLES, CEREALS AND WATER: WHEN THE LOCAL CONTEXT MATTERS MOST

Plant-based products may come into contact with contaminants through irrigation water, soil, atmospheric deposition or processing. For many of the families covered here, however, occurrence data in plant foods are more limited than those for certain animal matrices. A finding in one sample does not establish systematic contamination of an entire food category.

Water can provide a direct exposure route or act as an indirect source for crops and food production. For example, dietary relevance of chlorinated solvents in groundwater may depend on local contamination and actual water use. Results from drinking-water tests must be distinguished from tests on food: these matrices are not interchangeable.

A POSITIVE RESULT IS NOT A RISK RANKING

Proper interpretation requires at least four elements: the molecule or family tested; the concentration found; the amount and frequency of consumption; and the toxicological assessment available for that substance. A result that cannot be quantified does not necessarily indicate absolute absence: it may simply fall below the method's limit of quantification.

Exposure estimates can be affected by results below analytical limits, small sample numbers and geographical sampling patterns. EFSA uses different statistical scenarios where appropriate to account for incomplete data. Simplistic rankings such as 'this food is the worst' fail to capture this complexity and may mislead readers.

WHAT CAN WE CONCLUDE?

Scientific data indicate that seafood and some animal-derived foods are important for studying various persistent halogenated organic contaminants, whereas refined oils and foods containing them are relevant to certain processing contaminants such as 3-MCPD. Exposure to chlorinated solvents may depend principally on specific environmental and production conditions. No single food, however, is universally the most exposed to all these substances.

For consumers, the useful conclusion is not to eliminate entire food categories, but to recognise that testing must target relevant substances and appropriate matrices. The following chapters distinguish health effects more fully from mere analytical detection and examine the limitations of available controls.

SCIENTIFIC AND REGULATORY REFERENCES

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

[EFSA CONTAM Panel \(2021\). Update of the risk assessment of hexabromocyclododecanes \(HBCDDs\) in food. EFSA Journal 19\(3\), 6421.](#)

[EFSA CONTAM Panel \(2024\). Update of the risk assessment of polybrominated diphenyl ethers \(PBDEs\) in food. EFSA Journal 22\(1\), 8497 \(corrected July 2024\).](#)

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

[European Commission. Regulation \(EU\) 2023/915 on maximum levels for certain contaminants in food, consolidated text \(check amendments and application dates\).](#)