

WHICH FOODS CAN CONTAIN HIGHER LEVELS OF METALS?

Fish, rice, vegetables, cereals and nuts: when discussing metals in food, attention often focuses on very familiar products. But which contain higher levels? The answer depends first and foremost on which element is being considered. No single food is always “the most contaminated”, and there is no ranking that applies to all metals.

Another point is essential: metals such as iron, zinc and copper are necessary nutrients, whereas lead, cadmium and mercury warrant attention because of their potential toxic effects. Arsenic, although technically a metalloid rather than a metal, is also commonly considered alongside metallic contaminants in food safety studies. Assessing risk involves more than identifying an element: its chemical form, the amount present and the frequency with which the food is consumed must also be considered.

WHICH FOODS MAY CONTRIBUTE MORE TO EXPOSURE TO METALS?

It depends on the metal considered, its chemical form, the amount present and the frequency of consumption.

ARSENIC	CADMIUM	MERCURY	LEAD
As 	Cd 	Hg 	Pb 
Rice, rice-based products and some seaweeds may contribute to exposure. For arsenic, the inorganic form is especially important.	Cereals, potatoes, vegetables and some shellfish may contribute to exposure. Cadmium can accumulate in the body over time .	Large predatory fish may contain more mercury, especially in the form of methylmercury .	The contribution of lead can vary. Exposure depends on the environmental, production and dietary context.

THERE IS NO SINGLE 'WORST FOOD' IN ABSOLUTE TERMS:

what matters are the metal considered, the concentration present, the chemical form and the frequency of consumption.

RICE AND RICE-BASED PRODUCTS: FOCUS ON ARSENIC

Rice is one of the most extensively studied foods in relation to inorganic arsenic. It is often grown in flooded fields, where conditions may increase arsenic availability and uptake by the plant. However, concentrations vary according to geographical origin, growing conditions, rice variety and processing.

EFSA identifies rice and rice-based products, together with other cereals and cereal products, as major contributors to dietary exposure to inorganic arsenic in Europe. This does not mean that all rice products are dangerous, but it does mean that they deserve particular attention, especially when they form a substantial and regular part of the diet. It is also important to distinguish inorganic arsenic from certain organic arsenic compounds, which have different toxicological characteristics.

CEREALS, VEGETABLES AND NUTS: CADMIUM IS NOT LIMITED TO ONE FOOD

Plants can absorb cadmium from soil, allowing it to enter several food groups. Cereals and cereal products, vegetables, potatoes, pulses and nuts may all contribute to overall exposure, but the importance of each group depends both on its cadmium levels and on how much is consumed.

Cadmium illustrates an often-overlooked principle: a food with a relatively low concentration, if eaten every day, may contribute more to exposure than a food with a higher concentration eaten only occasionally. Products such as cocoa and its derivatives are also subject to specific maximum levels and monitoring. However, it would be misleading to treat all cereals, all vegetables or all nuts as homogeneous groups.

FISH AND SEAFOOD: THE PARTICULAR CASE OF MERCURY

Methylmercury is the form of mercury of greatest concern in dietary exposure through fish. It can accumulate in aquatic organisms and increase along food webs. As a result, some large, long-lived predatory species may contain higher concentrations than many smaller species.

Swordfish, certain large tuna species and other large marine predators are often covered by specific recommendations, particularly for pregnant women, children and people who frequently eat fish. Nevertheless, it would be wrong to conclude that “fish contains too much mercury”: levels vary considerably between species, individual specimens and areas of origin. Fish also provides important nutrients; a sensible approach is to vary the species consumed and follow public health authorities’ guidance.



LEAD: POSSIBLE SOURCES AND FOODS AFFECTED

Lead may enter food through environmental contamination, atmospheric deposition, water and, in certain circumstances, materials used in production or preparation. Cereals, vegetables and other plant-based foods may contribute to dietary exposure; their relative importance varies with consumption habits and local conditions.

The presence of lead cannot be identified simply by looking at a piece of fruit, a vegetable or a prepared dish. Moreover, part of total exposure may come from non-dietary sources. Risk assessments must therefore consider analytical data and the broader exposure context, avoiding generalisations about individual food categories.

SEAWEED, MOLLUSCS, OFFAL AND OTHER SPECIAL CASES

Some foods deserve closer examination precisely because they behave differently from more common food groups. Seaweed may contain arsenic in different chemical forms and, in some cases, substantial amounts of inorganic arsenic. Filter-feeding molluscs and other marine organisms may concentrate certain elements present in the aquatic environment. Offal, especially liver and kidneys, may accumulate some contaminants to a different extent than muscle meat.

These examples do not justify absolute rankings. The concentration measured in a sample depends on environmental conditions, species and food matrix; in some cases, testing must also distinguish between different chemical forms of the same element.

WHAT DOES “CONTAINING MORE” ACTUALLY MEAN?

To compare two foods, it is not enough to know that one contains more micrograms or milligrams of a particular metal per kilogram. We also need to ask which part is actually eaten, what a typical portion is, how often the food appears in the diet and whether the element is present in the chemical form of greatest toxicological relevance.

This is why a ranking without explanation can be misleading. A product showing relatively high levels in a single test is not necessarily the largest source of exposure for everyone. Conversely, widely consumed foods can make a significant contribution to total intake even when their individual concentrations are relatively low.

EUROPEAN CONTROLS: WHAT THEY TELL US AND WHAT THEY DO NOT

The European Union sets maximum levels for specified contaminants in particular food categories. Regulation (EU) 2023/915 includes, among others, limits for lead, cadmium, mercury and inorganic arsenic in certain products. These limits are not identical for every food: they reflect differences between food matrices and the available scientific assessments.

Official controls and risk assessment play an essential role. However, compliance with a maximum level does not demonstrate the complete absence of a contaminant, just as a higher concentration measured in one sample cannot, on its own, describe an individual's chronic exposure. Food safety relies on evidence, up-to-date scientific knowledge and oversight of supply chains—not on the visual impression that a product is more or less “natural”.

HOW TO INTERPRET THIS INFORMATION WITHOUT UNNECESSARY ALARM

The most useful conclusion is also the simplest: there is no need to indiscriminately eliminate rice, fish, cereals, vegetables or nuts. A more reasonable approach is to maintain a varied diet, follow recommendations for vulnerable population groups and pay attention to official information about products and supply chains.

However, establishing whether a particular element is actually present in a specific food requires laboratory analysis of representative samples. Scientific knowledge helps identify which foods deserve attention; analytical results take us beyond assumptions and describe the actual sample tested.

SCIENTIFIC AND REGULATORY REFERENCES

1. EFSA (2024). Inorganic arsenic in food – health concerns confirmed.

<https://www.efsa.europa.eu/en/news/inorganic-arsenic-food-health-concerns-confirmed>
<https://www.efsa.europa.eu/en/news/inorganic-arsenic-food-health-concerns-confirmed>

2. EFSA CONTAM Panel (2024). Update of the risk assessment of inorganic arsenic in food. EFSA Journal, 22(1), e8488.
<https://doi.org/10.2903/j.efsa.2024.8488><https://doi.org/10.2903/j.efsa.2024.8488>
3. EFSA (2009). Cadmium in food. EFSA Journal, 7(3), 980.
<https://doi.org/10.2903/j.efsa.2009.980><https://doi.org/10.2903/j.efsa.2009.980>
4. EFSA CONTAM Panel (2012). Mercury and methylmercury in food. EFSA Journal, 10(12), 2985.
<https://doi.org/10.2903/j.efsa.2012.2985><https://doi.org/10.2903/j.efsa.2012.2985>
5. European Commission. Regulation (EU) 2023/915 on maximum levels for certain contaminants in food (consolidated text, as amended). <https://eur-lex.europa.eu/eli/reg/2023/915/oj><https://eur-lex.europa.eu/eli/reg/2023/915/oj>