

CADMIUM IN FOOD: WHERE IT IS FOUND AND WHY IT RAISES CONCERN

Cadmium is an element naturally present in the Earth's crust, but its distribution in the environment can also be influenced by human activities. It can enter food primarily through soil and uptake by plants. It has no recognized nutritional function in the human body and, in cases of prolonged exposure, warrants attention because of its potential effects on health.



Which foods may contain higher levels? This is a useful question, but there is no universal ranking. Concentrations depend on the food matrix, soil characteristics, farming practices, and the origin of products. To understand the significance of an analytical result, it is necessary to distinguish the amount present in a particular food from the overall dose ingested through the diet.

WHERE DOES CADMIUM COME FROM?

Cadmium occurs at varying concentrations in rocks and soils. Natural background levels may be supplemented by inputs from industrial activities, atmospheric deposition and, under certain conditions, the past or present use of specific materials and fertilizers (e.g. commonly used phosphate fertilizers, which often naturally contain cadmium).

Cadmium levels are not the same in all soils, and a high concentration in soil does not automatically produce a corresponding increase in food.



The availability of cadmium to roots also depends on soil chemical properties, including pH, organic matter and interactions with other elements. In general, more acidic soils can increase cadmium mobility, but the response varies with plant species and agricultural conditions. As a result, two crops of the same species may yield different findings.

WHICH FOODS CONTRIBUTE TO EXPOSURE?

Cereals and cereal products, vegetables, potatoes and other tubers, pulses, tree nuts, oilseeds and cocoa-based products are among the foods considered in cadmium assessment and monitoring programmes. Some food matrices, including molluscs, offal, seaweed and certain mushrooms, may show relatively high concentrations. These examples do not mean that every product in these groups is contaminated to the same extent.

EFSA assessments of dietary exposure in Europe highlight a crucial point: cereals, baked goods and vegetables can make substantial contributions to total intake because they are eaten regularly. A food with a moderate concentration consumed every day may contribute more than a food with a higher concentration eaten only occasionally.

However, the proportions identified in historical surveys should not be treated as universally applicable to every country, individual or period.

THE CASE OF COCOA AND CHOCOLATE

Cocoa and chocolate deserve particular attention because cadmium accumulation in cocoa beans can vary substantially with geographical origin and soil conditions. The concentration in the finished product also depends on its formulation and cocoa content. It would be incorrect to assume that all dark chocolate has high levels, or that its colour or cocoa percentage alone reveals the actual concentration.



European legislation sets separate maximum levels for different categories of chocolate and for cocoa powder sold to consumers. This approach reflects differences among food matrices and means that laboratory results must be compared with the appropriate regulatory category.

WHY CADMIUM IS SUBJECT TO TOXICOLOGICAL ASSESSMENT

Cadmium absorbed by the body is eliminated slowly and can accumulate over time, particularly in certain tissues. The kidneys are an important target organ for chronic exposure; scientific assessments also consider effects on bone metabolism and other possible health outcomes. Such effects depend on the dose and duration of exposure and cannot be inferred simply from detecting the element in a single food.

For non-smokers, diet is one of the main routes of exposure. Tobacco smoke represents an additional significant source, so dietary exposure should be distinguished from overall exposure. Individual factors, including nutritional status, can also influence cadmium absorption.

THE TOLERABLE WEEKLY INTAKE: WHAT DOES IT MEAN?

In 2009, EFSA established a tolerable weekly intake (TWI) for cadmium of 2.5 micrograms per kilogram of body weight, subsequently reaffirmed in 2011. The TWI is a toxicological reference value for assessing long-term exposure: it is neither the legal maximum permitted concentration of cadmium in a food nor a threshold beyond which harm automatically occurs.

For example, for a person weighing 70 kg, this corresponds to 175 micrograms per week. This is an arithmetic example intended to explain the unit of measurement, not personalized dietary advice. An actual assessment requires information on food consumption, concentrations in different foods, and uncertainties in the estimates. Exceeding the TWI indicates that long-term exposure should be reduced; it is not a diagnosis of toxicity.

EUROPEAN MAXIMUM LEVELS AND OFFICIAL CONTROLS

Commission Regulation (EU) 2023/915, as amended over time, establishes maximum levels of cadmium for numerous food categories. The limits are not the same for all products: they differ, for example, among certain types of fruit and vegetables, cereals, tree nuts, molluscs, cocoa and chocolate. Correctly interpreting an analytical certificate requires checking the exact legal entry, any accompanying notes and the edible portion to which the limit applies.

Compliance with the applicable maximum level is a fundamental condition for marketing the products concerned, but it does not demonstrate the complete absence of the contaminant. Equally, measurable cadmium does not automatically mean that a food is unsafe. Official controls, exposure assessment and risk characterization address different but complementary questions.

HOW TO INTERPRET LABORATORY ANALYSES

An analysis can determine the concentration of cadmium in a sample, generally expressed in milligrams per kilogram (mg/kg). When comparing results from different laboratories or batches, it is necessary to consider the analytical method, limit of quantification, sampling procedure, measurement uncertainty and correct identification of the food matrix. A result below the limit of quantification does not demonstrate absolute absence: it means that the substance was not quantified at the stated level of analytical sensitivity.

The sample must also be representative of the batch being assessed. Analytical results describe the condition of the sample tested and, with an appropriate sampling plan, can support decisions concerning the batch. Taken alone, however, they cannot establish a person's overall dietary exposure.

WHAT ARE REASONABLE PRECAUTIONS?

There is no justification for indiscriminately removing cereals, vegetables, pulses, tree nuts or cocoa from the diet simply because they might contain cadmium. A varied diet, supply-chain monitoring and adherence to public health authorities' guidance are more sensible approaches than absolute rankings or alarmist claims about individual foods.

The central message is that concentration and risk are not synonymous. Science identifies the foods and conditions that merit attention; controls verify compliance, and laboratory analyses document what is present in tested samples. Access to analytical data helps avoid both unwarranted reassurance and generalized fear.

SCIENTIFIC AND REGULATORY REFERENCES

- [EFSA CONTAM Panel \(2009\). Cadmium in food. EFSA Journal, 7\(3\), 980.](#)
- [EFSA CONTAM Panel \(2011\). Statement on tolerable weekly intake for cadmium. EFSA Journal, 9\(2\), 1975.](#)
- [EFSA \(2012\). Cadmium dietary exposure in the European population. EFSA Journal, 10\(1\), 2551.](#)
- [EFSA. Metals as contaminants in food \(topic overview and updates\).](#)
- [European Commission. Regulation \(EU\) 2023/915 on maximum levels for certain contaminants in food \(consolidated text and amendments\).](#)