

4. ARSENIC IN RICE AND OTHER FOODS



Arsenic occurs naturally in the Earth's crust and can enter water, soil and food through natural processes and human activities. When discussing arsenic in food, rice often attracts particular attention. However, it is not the only source of exposure, and the presence of arsenic does not always carry the same health implications: its chemical form, concentration and dietary habits all matter.

TOTAL ARSENIC AND INORGANIC ARSENIC ARE NOT THE SAME

"Total arsenic" refers to the sum of the different chemical species present in a sample. From a toxicological standpoint, distinguishing among them is essential. Inorganic arsenic mainly comprises arsenite [As(III)] and arsenate [As(V)] and is the form of greatest concern in chronic dietary exposure. Food can also contain organic arsenic compounds, including methylated forms and more complex species characteristic of certain marine products.

It is not scientifically correct to claim that all organic arsenic is harmless. Different compounds have different toxicological profiles, and uncertainties remain for some of them. EFSA's 2024 assessments of organoarsenic species specifically examined these differences. Consequently, a result reporting only "total arsenic" does not always allow an adequate assessment of risk: chemical speciation analysis may be necessary.

WHY RICE CAN ABSORB ARSENIC

Rice is frequently grown in flooded soils. Under low-oxygen soil conditions, certain chemical and microbiological processes can increase arsenic mobility and make it more available to plant roots. In addition, arsenite can enter the plant through transport pathways also used by other elements. The outcome is not uniform: the final concentration depends on the soil, irrigation water, variety, crop management and grain processing.



Brown rice often contains more inorganic arsenic than white rice from the same source because some of the element accumulates in the outer layers removed during milling. This difference, by itself, does not amount to an overall nutritional judgement: those outer layers also contain valuable fibre and nutrients. A meaningful comparison must therefore consider both nutritional characteristics and contaminant exposure.

NOT ALL RICE IS THE SAME

Geographical origin can influence arsenic levels, but it cannot automatically establish whether all rice from a particular country is safe or problematic. Soils and irrigation water can vary even within small areas. Cultivar, season and farming techniques also matter. Statements such as “rice from a given origin is always more contaminated” are not supported without representative and comparable data.

Rice-derived products also deserve attention: flour, rice cakes, snacks and rice-based drinks may contribute to overall exposure, especially when consumed frequently and consistently used in place of other cereals.

WHICH OTHER FOODS CONTRIBUTE TO EXPOSURE?

EFSA also identifies other cereals and cereal-based products as relevant contributors, depending on dietary patterns and age. Exposure to inorganic arsenic therefore does not depend exclusively on rice. Drinking water can be another important source in areas where geological conditions lead to elevated concentrations; in Europe, water intended for human consumption is subject to specific monitoring and controls.

Fish, crustaceans, molluscs and seaweed can contain relatively high levels of total arsenic, but their distribution of chemical species often differs from that found in rice. Organic forms predominate in many marine organisms, while certain seaweeds may contain appreciable quantities of inorganic arsenic. It is therefore misleading to compare two foods solely on the basis of total arsenic.

WHAT EFSA TELLS US ABOUT HEALTH RISKS

In its assessment published in 2024, EFSA confirmed that dietary exposure to inorganic arsenic raises public-health concerns. Epidemiological studies associate long-term exposure with an increased risk of certain cancers, including cancers of the skin, bladder and lung. The risk assessment concerns exposure sustained over time; it does not imply that occasionally eating a single food automatically causes harm.

EFSA uses a margin-of-exposure approach rather than interpreting one concentration measured in food as a universal boundary between safety and danger. Uncertainties remain, including those related to individual variability and exposure estimates. Groups that consume large quantities of rice-based products, including very young children, warrant particular attention when assessing dietary habits.

EUROPEAN LIMITS: SOME PRACTICAL EXAMPLES

Regulation (EU) 2023/915 establishes maximum levels of inorganic arsenic for specific product categories. For example, the legal text lists 0.15 mg/kg for non-parboiled white rice, 0.25 mg/kg for brown and parboiled rice, 0.10 mg/kg for rice intended for the production of food for infants and young children, and 0.030 mg/kg for rice-based non-alcoholic beverages. These are distinct legal categories: the values and definitions must always be checked against the applicable consolidated legislation.

Compliance with a legal limit confirms that a product meets that particular requirement; it does not prove the complete absence of the contaminant or automatically eliminate its contribution to cumulative exposure. Conversely, exceeding the maximum level in a product is a regulatory compliance issue to be addressed under the law, not a direct measurement of clinical risk for an individual.

RINSING AND COOKING: WHAT REALLY CHANGES

Domestic preparation can change the amount of arsenic in rice. Some studies show that cooking rice in excess water and then draining it can remove a substantial proportion of inorganic arsenic; the extent of the reduction varies with the rice and the procedure. Preliminary rinsing alone, on the other hand, often has only a modest effect.



There is a trade-off: cooking in excess water and discarding it can also reduce some vitamins and minerals, particularly in enriched rice. It is also essential to use water of suitable quality: contaminated water can make matters worse. These measures do not replace controls on the product at its source.

HOW TO INTERPRET A LABORATORY ANALYSIS

To assess a batch of rice, it is first necessary to know which parameter was measured: total arsenic or inorganic arsenic. The concentration, unit of measurement, method's limit of quantification (LOQ), analysed matrix, sampling plan and measurement uncertainty, where relevant, must also be known. A result from a single sample does not necessarily describe every batch of the same product.

The most scientifically robust approach distinguishes three questions: Does the product comply with the law? How much inorganic arsenic is actually present in the sample? How much does it contribute to the consumer's exposure, taking portion sizes and frequency into account? These questions are related, but they are not equivalent.

HOW TO REDUCE EXPOSURE WITHOUT ALARMISM

There is no need for the general population to eliminate rice from the diet. A reasonable approach is to alternate rice with other cereals and maintain a varied diet, paying particular attention to daily reliance on rice-based foods in young children's diets. When selecting a cooking method to reduce arsenic, the balance between contaminant reduction and nutrient loss should be considered.

The distinction between general guidance and a verified measurement remains crucial. Scientific knowledge indicates where to look and which substances to measure; only appropriate analyses of representative samples can establish the results for a specific product or batch. This is the informational principle underlying the Overorganic approach.

SCIENTIFIC AND REGULATORY REFERENCES

- [EFSA CONTAM Panel \(2024\). Update of the risk assessment of inorganic arsenic in food. EFSA Journal, 22\(1\), e8488.](#)
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- [EFSA \(2024\). Risk assessment of small organoarsenic species in food.](#)
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- [European Commission. Regulation \(EU\) 2023/915 on maximum levels for certain contaminants in food \(consolidated text and subsequent amendments\).](#)
- [U.S. FDA. What You Can Do to Limit Exposure to Arsenic.](#)
- [Gray, P. J. et al. \(2016\). Cooking rice in excess water reduces both arsenic and enriched vitamins in the cooked grain. Food Additives & Contaminants.](#)