

Heavy Metals and Metalloid (As) in Foodstuff and the Risk Assessment for the Human Health

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Environmental contamination of food

Environmental contamination include substances from natural sources or from industry and agriculture. Many of the naturally occurring contaminants in food are of microbiological origin and consist of harmful bacteria, bacterial toxins, and fungal toxins. Aflatoxin, a contaminant of peanuts and grains, is an example of a fungal toxin or mycotoxin [1].

The second category of environmental contaminant, include organic chemicals, metals and their complexes, and radionuclides. Only those environmental contaminants introduced into food as a result of human activities such as agriculture, mining, and industry are considered in this assessment [2].

The environmental contamination of food is a result of our modern, high-technology society. We produce and consume large volumes of a wide variety of substances, some of which are toxic [1,3].

How food becomes contaminate

Chemicals contaminate foods through different routes depending on the chemical and its physical properties, its use, and the source or mechanism of contamination [3,4]. Metals can be released into the environment in several ways. The mining and refining processes produce dust and gases which enter the atmosphere. Metallic salts formed during recovery and refining processes can scape as waste products into surface and ground water [2,5]. Sewage sludge used as fertilizers on agricultural land also poses a potential food contamination problem. Trace metals present in the sludge can be taken up by crops grown on treated soil [1,5]. Cadmium is the trace metal in sludge that currently generates the greatest concern [6].

Heavy metal content of foods

Metals occur in all foodstuffs. Of particular concern is the presence of toxic metals, which include lead (Pb), cadmium (Cd), arsenic (As, metalloid) and mercury (Hg) [1,2,5]. The toxic metal content of foods is influenced by many factors ranging from environmental conditions during growth to post-harvest handling, processing, preparation and cooking techniques [3,6]. For example, metal content increases in some commodities grown in contaminated soils or atmospheres while post-harvest handling steps such as washing generally remove metal contaminants [5,7]. Cooking may reduce metal content although some foods can absorb metal if the cooking water is contaminated [6,7].

Assessing health risks

Once ingested, a chemical (heavy metal), may exert an action locally in or on the stomach or intestines. While such effects possibly could be produced by environmental contaminants, they are not likely to be observed at the low levels normally encountered in food. The more serious concern is the systemic effects that may occur after absorption from the gastrointestinal tract [4,8].

Following absorption from the gastrointestinal tract, some heavy metals may produce their effect by acting on a target organ, by acting on different target organs or systems or by acting differently on different organs to produce the same effect. Most of the interactions are at the biochemical level and the mechanisms are still being studied [4,8].

Dose-response models for low-dose risk assessment provide a useful technique for assessing the possible added risk attributable to environmental contaminants, such as toxic heavy metals. Such models also might well be used in place to safety factors in future procedures adopted for food contaminant regulations [1,9].

Health risk evaluation of heavy metals intake are generally based on the metal content of raw products. However, food is often consumed after being processed and cooked, which could alter the concentration as well as its chemical speciation [6,11].

To evaluate the health risks of estimated dietary exposure, the values are compared to the Provisional Tolerable Weekly Intake (PTWI) recommended by the Joint FAO/WHO Expert Committee for Food Additives (JECFA) [10,11].

Metal content of food at the point of consumption can be minimized by careful selection of growth, post-harvest handling, in-plant processing and home preparation conditions.

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