ENVIRONMENTAL TOXINS IN FOODS

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Contamination by chemicals from the environment is a major global food safety issue, posing a serious threat to human health.

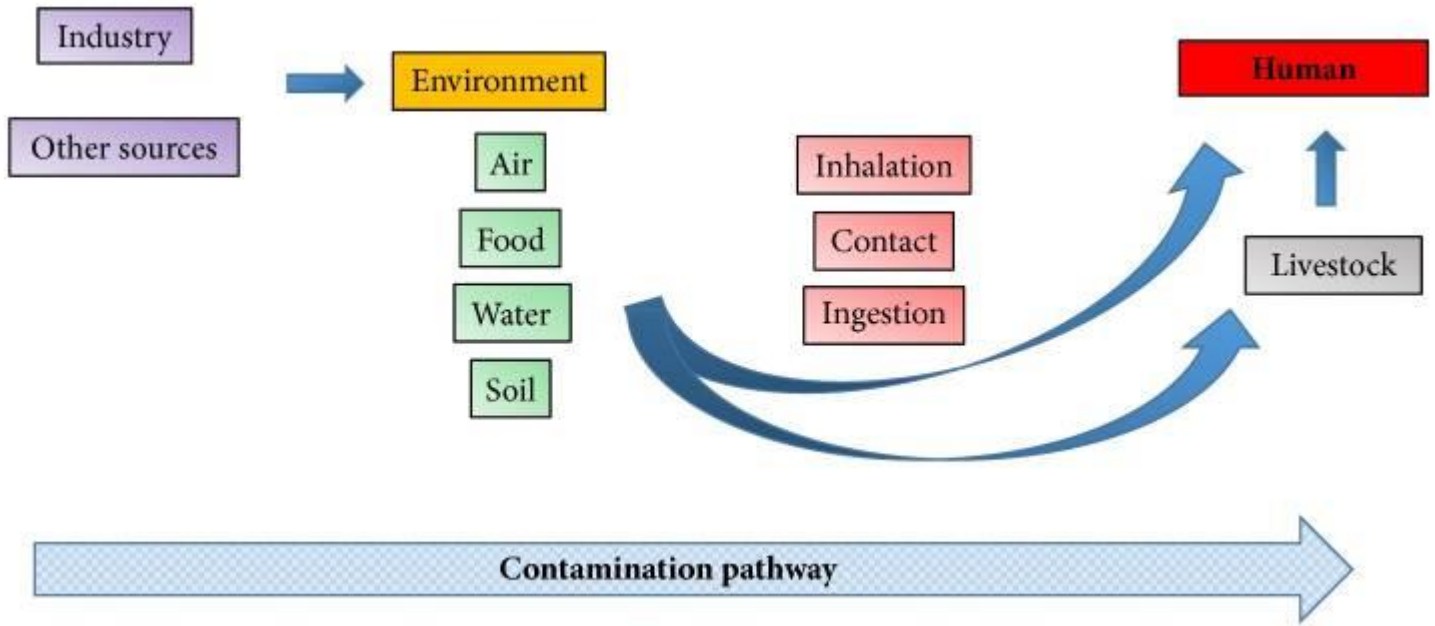
Some of these occur naturally in the environment, whilst others are produced from anthropogenic sources. They may contaminate our food—crops, livestock, and seafood—and drinking water and exert adverse effects on our health.

Due to the nature of contamination, some food products may be more contaminated than others. This may be due to several factors such as varying exposure to pesticides, differences in plant uptake mechanisms from the environment, or contaminants from food packaging

For most contaminants, there is no completely safe dose level. However, for many, acceptable levels have been calculated levels below which signs of toxicity should not be evident. Toxic effects seen depend on the contaminant in question, the dose received, and the individual.

Many contaminants have been linked to an increased risk of cancer. Skin cancer has been associated with long-term exposure to drinking water contaminated by arsenic, gastric cancer with lead contamination, and liver cancer with consumption of grain contaminated by mercury.

Our understanding of the health risks from combined exposures to more than one contaminant and the means by which we can assess such interactions is lacking .


Industry
Other sources
Environment
Air
Food
Water
Soil
Inhalation
Contact
Ingestion
Human
Livestock
Contamination pathway

Sources of Contaminants from the Environment to Food and Water

Arsenic, Lead, Mercury, and Cadmium, sometimes referred to as heavy metals or toxic elements, may occur naturally in the environment and are often at higher levels from past industrial uses and pollution

In 2021, the FDA began its Closer to Zero initiative to outline the agency's actions for reducing lead, arsenic, cadmium, and mercury in foods intended for babies and young children.

LEAD

- Complications in the nervous system and red blood cells
- Reduction in cognitive development and intellectual performance
- Death among children

lead still comes from metal smelting, battery manufacturing, and other factories that use lead. This lead gets into the air and then mixes with the soil near homes, especially if the home is near one of these sources

CADMIUM

- Renal tubular dysfunction
- High risk of lung and breast cancer
- Osteomalacia and osteoporosis

Cadmium is used in batteries, paints, plastics and electroplating, among others. It is released to the atmospheric environment from metals production and fossil fuel combustion. Phosphorous fertilizers and sewage sludges are also a major source of environmental releases of cadmium.

ARSENIC

Associated with dermal, respiratory, nervous, mutagenic, and carcinogenic effects

Arsenic levels tend to be higher in groundwater sources, such as wells, than surface sources, such as lakes or reservoirs. Contamination from mining and fracking, coal-fired power plants, arsenic-treated lumber, and arsenic-containing pesticides also contributes to increased levels of arsenic in certain locations.

MERCURY

Linked to cardiovascular, reproductive, and developmental toxicity, neurotoxicity, nephrotoxicity, immunotoxicity, and carcinogenicity

Mercury can be released to the environment through the decomposition of vegetation, forest fires, emission from water bodies, particles in air from sea salt spray, and leaching from soils into water.

NICKEL

Associated with dermatotoxicity, lower body weight, and fetotoxicity among pregnant women

Natural sources of atmospheric nickel include wind-blown dust, derived from weathering of rocks and soils, forest fires and volcano activities. The presence of nickel in the air also derives from the combustion of coal, diesel oil and fuel oil, and the incineration of waste and sewage

AFLATOXIN

- Immunodeficiency
- Aflatoxicosis
- Primary hepatocellular carcinoma
- Liver cirrhosis

DEOXYNIVALENOL

- Impaired intestinal integrity
- Impaired gut-associated immune system

Deoxynivalenol is a trichothecene mycotoxin produced by Fusarium to which wheat, barley, maize (corn) and their products are susceptible to contamination.

ZEARALENONE

- Hyperestrogenism and reproductive dysfunction

Zearalenone (ZEA) is a non-steroidal estrogenic mycotoxin produced by several fungi of the Fusarium sp. that contaminates cereal crops such as maize, barley, wheat, oats, sorghum, and sesame grains across the world .

FUMONISINS

- Esophageal cancer and birth defects

Fumonisins are secondary metabolites produced in cereals by pathogenic fungi, namely Fusarium verticillioides, Fusarium proliferatum, and related species . Moreover, Aspergillus nigri also produces fumonisins in the crop plants of peanut, maize, and grape

BENZO[A]PYRENE

- Mutagenicity and carcinogenicity
- DNA damage and oxidative stress
- Impaired male fertility
- Respiratory diseases
- Cognitive dysfunction among children

Benzo(a)pyrene is found in nature from the eruption of volcanoes and forest fires. Yet this chemical compound is also man-made. Benzo(a)pyrene can be found in surface water, tap water, rainwater, groundwater, wastewater and sewage sludge.

CHLORPYRIFOS

- Neurological symptoms

Chlorpyrifos (**CPS**), also known as **chlorpyrifos ethyl**, is an organophosphate pesticide that has been used on crops, animals, in buildings, and in other settings, to kill several pests, including insects and worms

DDTS

- Neurological symptoms
- Endocrine disruption
- Infertility and fetal malformation

DDT is present at many waste sites, releases from these sites might continue to contaminate the environment. Most DDT in the environment is a result of past use; DDT was also used as a pesticide to a limited extent in the past.

PCBS(POLYCHLORINATED BIPHENYLS

- Neurological disorders
- Endocrine disruption
- Neurotoxicity
- Cancer

Polybrominated and polychlorinated compounds may originate from anthropogenic and natural sources. They have many uses such as flame retardants and dielectric/coolant fluids in electrical apparatus

ACRYLAMIDE

Generally associated with high heat cooking processes (e.g., in breads and baked or fried potatoes)—and is also manufactured for commercial and industrial uses (such as in paper and dye production, in wastewater treatment, and as a chemical grouting agent)

The two-year NTP studies of acrylamide, given in an animal's drinking water, found clear evidence of carcinogenic activity in male and female rats and mice, based on tumors in multiple sites. For example, tumors were found in the mammary and thyroid glands in female rats, and the reproductive organs in male rats. Tumors of the lung were among those observed in mice.

Microplastics and Nano plastics resulting from plastics that break down from weathering in the environment over time.

While many studies have reported the presence of microplastics in several foods, including salt, seafood, sugar, beer, bottled water, honey, milk, and tea.There are no standardized methods for how to detect, quantify, or characterize microplastics and nanoplastics, many of the scientific studies have used methods of variable, questionable, and/or limited accuracy and specificity.

PLASTICS

Factors such as higher storage temperatures and prolonged contact time with the packaging were linked to higher levels of contamination, but a health risk assessment showed that the risk for consumers was low.

The FDA continues to monitor the research on microplastics and nanoplastics. If the FDA determines, based on scientific evidence, that microplastics or nanoplastics in food, including packaged food and beverages, adversely affect human health, the FDA can take regulatory action to protect public health.