

Cadmium

Cadmium (Cd) is a highly toxic heavy metal to all living organisms. Bivalves can accumulate this toxic metal and act as suitable bioindicator for pollution monitoring. Biomagnification of Cd also happens in the food chain and increased concentration will reach the end of food chain.

Lead

Lead (Pb) is a highly toxic metal in aquatic system in which fish are at the top of food chain. The International Agency for Research on Cancer classified inorganic lead as probably carcinogenic to humans (Group 2A) in 2006. In addition to fish, the other sources of Pb include bivalves, cephalopods, crustaceans and oysters.

Permissible limit (mg/Kg)

Heavy metals	EU	USFDA	Codex	India
Mercury	Fishery products -0.5 Certain fishes- 1	All fishes (methyl mercury) - 1	Fishes - 0.5 Predatory fishes - 1	Fishes - 0.5 Predatory fishes - 1
Cadmium	Crustaceans - 0.5 Bivalves - 1 Cephalopods - 1 Fishes - 0.05 to 0.1	Crustaceans - 3 Bivalves - 4	Bivalves - 2 Cephalopods - 2	Fish - 0.3 Crustaceans - 0.5 Bivalves - 2 Cephalopods - 2
Lead	Crustaceans - 0.5 Bivalves - 1 Cephalopods - 1 Fishes - 0.2 to 0.4	Crustaceans - 1.5	Fish - 0.3	Fish - 0.3 Crustaceans - 0.5 Bivalves - 1.5 Cephalopods - 1
Arsenic	NIL	Crustaceans - 76 Bivalves - 86	NIL	Fish - 76 Crustaceans - 76 Bivalves - 86

Heavy metal contamination in seafood



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Heavy metals in seafood

Heavy metals are commonly occurring environmental chemical contaminant in seafood. It include lead, cadmium, arsenic and mercury. These metals are highly toxic in nature with high environmental persistence and become a serious issue through bioaccumulation and biomagnification of food chain. Fishes can uptake and concentrate metals from water, other small fishes and vegetation. Accumulation in the tissue can depend upon environmental concentration and exposure period. Fishes can uptake and concentrate metals from water, other small fishes and vegetation. Accumulation in the tissue can depend upon environmental concentration and exposure period. Also in an aquatic ecosystem fishes are the most important bio monitor for estimation of heavy metal contamination. Based on the degree of toxicity, maximum allowable limit (MAL) is determined which is a limit above which the consumers are exposed to harmful contamination.

- **Natural sources** - atmospheric deposition, marine volcanism, geological anomalies and geothermal events
- **Anthropogenic sources** - industrial effluents, mining wastes, intensive metallurgy and acidic rain

Mercury

Mercury (Hg) is the metal of most concern and fish is considered as the most important source of mercury in case of humans. It can be methylated to form organic mercury called methylmercury (MeHg) which is the chronic toxic form of mercury. The major symptoms of MeHg in humans are impaired vision and hearing, headache, paraesthesia, difficulty in movement, less coordination, fatigue, tremors and ataxia

Arsenic

Arsenic (As) is widely distributed in the environment due to natural and anthropogenic sources. Arsenic is present in both organic and inorganic form and the most toxic one among them is inorganic As which is stable, highly soluble and can be absorbed into the body easily. The various symptoms of As exposure in humans include abdominal pain, vomiting, diarrhea, muscle weakness and skin flushing

Methyl mercury

- ❑ Mercuric chloride (HgCl_2), mercurous chloride (Hg_2Cl_2), mercuric sulfide (HgS) are common forms of inorganic mercury occur in nature.
- ❑ Although inorganic forms are non-toxic, they can be methylated to form organic mercury called methylmercury (MeHg) which is the chronic toxic form of mercury
- ❑ Sulfate reducing bacteria are the major contributors of Hg methylation in natural waters
- ❑ In human it can reach and accumulate in the brain via blood and result loss of cells in specific brain areas and also affect other target organs like pituitary gland, liver and kidney.
- ❑ Mercury in higher concentrations is present in large predatory fishes

Inorganic arsenic

- ❑ Inorganic arsenic compounds contain arsenic with a non carbon element such as oxygen which has more severe level of toxicity and health effects compared to organic form
- ❑ Long term exposure leads to skin disorders and increased risk for skin, bladder and lung cancers.
- ❑ Very high amount exposure in short term can result nausea, vomiting, bruising, numbness etc.
- ❑ Although total As is measured instead of inorganic As (Arsinite), 90% of As present in fish and crustaceans is in non toxic arsenobetain form. While in case of mollusks and algae it is present in the form of arsenocholine and arsenosugar respectively.

Analysis of toxic forms of methyl mercury and inorganic arsenic in seafood has to be done using precise and robust analytical methods with prime importance. The most widely used analytical techniques are

- Atomic Absorption Spectrometry
- Inductively Coupled Plasma-Mass spectrometry (ICP-MS)
- Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)

