Arsenic-organic

Updated: November 2018

Arsenic has chemical and physical properties intermediate between a metal and a nonmetal, and is often referred to as a metalloid or semi-metal [IARC].

Arsenic can exist in four oxidation states: -3, 0, +3 and +5. Elemental arsenic is not soluble in water. In water, arsenic is mostly found in inorganic forms as oxyanions of trivalent arsenite (AsIII) or pentavalent arsenate (AsV). Under oxidizing conditions, arsenate is dominant whereas, under reducing conditions, it is more likely to be present as arsenite [The Danish Environmental Protection Agency].

From a biological and toxicological perspective, there are three major groups of arsenic compounds:

- inorganic arsenic compounds,
- organic arsenic compounds,
- arsine gas [IARC].

Common organic arsenic compounds include arsanilic acid, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA-cacodylic acid), and arsenobetaine [IARC].

Organic arsenic is in the form of a molecule that has at least one carbon atom.

Organoarsenicals, which occur naturally and in many synthetic forms, vary widely in their toxicological attributes, from the virtually nontoxic natural compound arsenobetaine widely encountered in seafood, to the highly toxic vesicant warfare agent lewisite. Arsine, a hydride gas is a potent hemolytic agent [LaDou J].

Organic arsenic compounds (for example, arsenobetaine) are found mainly in fish and shellfish [CDC].

The toxicity of MMA and DMA is distinctly lower than that of the inorganic species. Nowadays arsenobetaine, arsenocholine and arsenosugar are even regarded as non-toxic [Arsenic species].

Usage and exposure

Organic arsenic was used in antibiotics for the treatment of spirochetal and protozoal disease [IARC].

Organic forms of arsenic were constituents of some agricultural pesticides in the USA. However, in 2009, the US Environmental Protection Agency issued a cancellation order to eliminate and phase out the use of organic arsenical pesticides by 2013 (EPA, 2009). The one exception to the order is monosodium methanearsonate (MSMA), a broadleaf weed herbicide, which will continue to be approved for use on cotton. Small amounts of disodium methanearsonate (DSMA, or cacodylic acid) were historically applied to cotton fields as herbicides, but its use is now prohibited under the aforementioned US EPA 2009 organic arsenical product cancellation. Other organic arsenicals (e.g. roxarsone, arsanilic acid and its derivatives) are used as feed additives for poultry and swine to increase the rate of weight gain, to improve feed efficiencies, pigmentation, and disease treatment and prevention [IARC].

Organic arsenic (e.g. arsenobetaine) is found in seafood, fruit, and vegetables [IARC].

Routs of exposure:

Inhalation, ingestion**.**

Metabolism

The major part of the arsenobetaine and arsenocholine is excreted without being metabolized [Arsenic species]**.**

Health hazards

Dimethylarsinic acid (**Cacodylic acid)** and monomethylarsonic acid are possibly carcinogenic to humans (Group 2B).

Arsenobetaine and other organic arsenic compounds not metabolized in humans, are not classifiable as to their carcinogenicity to humans (Group 3) [IARC].

References:

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