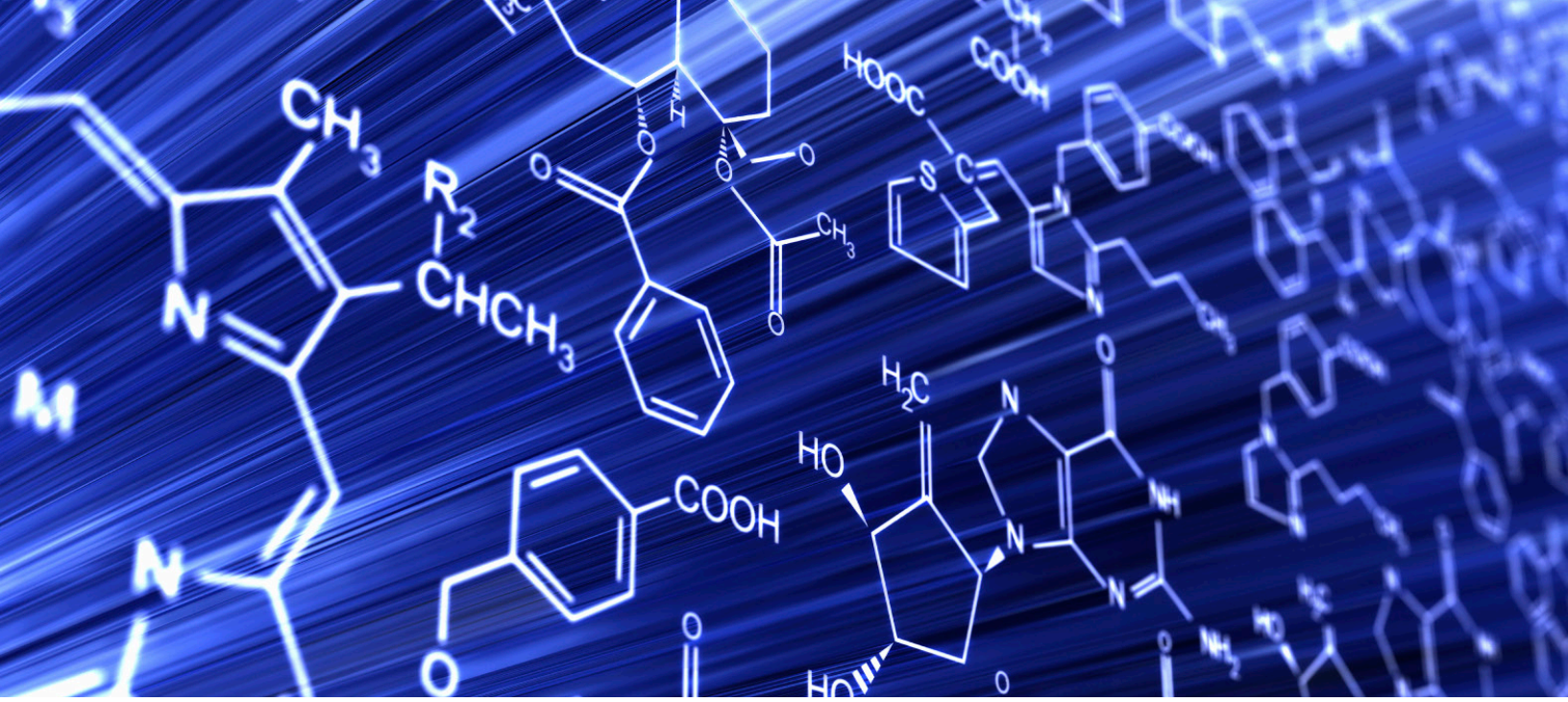

A Second Look at Arsenic – A Guide to Inorganic & Organic Arsenic Testing

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AN AWARENESS GUIDE FOCUSED ON ARSENIC IN FOOD AND THE IMPORTANCE OF DETECTING BOTH INORGANIC & ORGANIC FORMS.

- What is Arsenic?
- Inorganic vs. Organic Forms
- How is Arsenic Used?
- Sources of Arsenic Exposure
- Rice & Arsenic
- Testing for Arsenic
- References

WHAT IS ARSENIC?

Arsenic (As) is a naturally occurring element that can be found in small amounts throughout the environment (e.g., rocks, soil, water, air, plants, animals, etc.). It is also sometimes released into the environment as a by-product of agricultural and industrial processes. Arsenic is odorless and tasteless. Like boron and silicon, arsenic is classified as a Metalloid (an element with properties that are somewhat like a metal and somewhat like a nonmetal). Arsenic can be found in several forms; such as, metallic, gray, yellow and black arsenic. In industry, arsenic appears most commonly as a steel grey metal; however, it is also frequently found as a component of inorganic or organic chemical compounds.

INORGANIC V. ORGANIC FORMS

Arsenic can be part of both inorganic and organic compounds:

Inorganic arsenic compounds contain arsenic combined with oxygen, iron, chlorine and sulfur. These are found primarily in industrial settings, where they have been used in various pesticides and wood preservatives. Inorganic forms of arsenic are considered more toxic than organic forms and have been linked to cancer.

Organic arsenic compounds are commonly found in nature. These are composed of arsenic combined with carbon atoms. While organoarsenic compounds are thought to be less harmful to humans in small doses than inorganic arsenic compounds, concerns have been raised about potential health risks regarding two specific organoarsenic forms, di-methylarsinic acid (DMA) and mono-methylarsonic acid (MMA). Recently, DMA and MMA have been labeled as possible human carcinogens by the International Agency for Research on Cancer.

HOW IS ARSENIC USED?

Arsenic has been used in many ways, including:

- As a preservative in pressure treated lumber (U.S. residential use ended in 2003)
- In pesticides (U.S. agriculture use of inorganic arsenic ended in 1993)
- As a preservative in animal hides
- As a hardening additive in lead and copper
- In some glass manufacturing

SOURCES OF ARSENIC EXPOSURE:

Humans are exposed to small amounts of arsenic every day. Small amounts of arsenic are inhaled from the air we breathe and ingested from the water and food we consume. In low doses, arsenic exposure is not harmful to humans but when high levels of arsenic are encountered for an extended period of time, negative side effects may occur.

Although uncommon in the U.S., some jobs can expose people to higher levels of arsenic. Some examples of these jobs are copper / lead smelting, wood treatment, or pesticide application. Regulations are in place to limit workplace exposure.

Living close to places that are (or were) industrial or agricultural sources of arsenic may increases chances of arsenic exposure. Facilities such as wood preservative and glass factories may contaminate nearby air, soil or water. Communities near smelters or near fields or orchards where arsenic-containing pesticides were used may have contaminated soil. Burning fossil fuels (such as coal) and tobacco can release small amounts of arsenic into the air.

Consumption of arsenic contaminated drinking water is the biggest contributor to arsenic exposure worldwide. Most U.S. areas with higher levels of naturally occurring arsenic in drinking water are rural communities with the exception of Albuquerque, New Mexico. Levels tend to be greater in water that comes from ground sources, like wells, as opposed to water from surface sources. Regulations in the U.S. by the Environmental Protection Agency (EPA) limit the maximum level for total arsenic permitted in drinking water to 10 parts per billion (ppb).

For most residents in industrialized countries, food is a more likely source of arsenic than drinking water. Although most arsenic in food is likely to be present in the less harmful organic form, continuous exposure over a long period of time may contribute to health problems. Foods that have naturally high arsenic concentrations are seafood, rice, rice cereal, and mushrooms.

RICE & ARSENIC

As mentioned earlier, rice and rice products can sometimes contain high levels of arsenic. Rice, like most other plants, can absorb arsenic from the surrounding soil or water. But unlike other crops, rice is one of the only plants that are cultivated in water-flooded conditions. These conditions create an ideal environment for large amounts of arsenic to be easily absorbed and stored in the grain kernels. The bran and germ of the rice kernel is usually where the arsenic accumulates. The starchy white rice endosperm may contain some as well, but it is most prevalent in the bran. For this reason, brown rice usually contains more arsenic than varieties of white rice. Currently, FDA has not set a limit for arsenic in most foods.

TESTING FOR ARSENIC:

New advancements in science have recently provided the ability to selectively measure the different forms of arsenic present in foods. By separately quantifying the amounts of inorganic and organic arsenic, a better understanding of the amounts of arsenic present in foods and the environment can be achieved.

Eurofins offers U.S. FDA protocols for both total arsenic and inorganic arsenic analyses (arsenic speciation) of foods using ICP-MS and LC-ICP-MS methods.

Arsenic Speciation Analysis in Rice

Arsenic Species	Chemical Form	Limit of Quantification
Arsenic III	Inorganic	0.01 mg / kg
Arsenic V	Inorganic	0.02 mg / kg
Total Inorganic Arsenic	Inorganic	0.01 mg / kg
DMA	Organic	0.01 mg / kg
MMA	Organic	0.01 mg / kg
Arsenic	Organic & Inorganic	0.02 mg / kg

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