

Dartmouth Toxic Metals Superfund Research Program



Arsenic in Rice Your Questions and Answers



What is arsenic?

Arsenic is a chemical element present in the environment from both natural and human sources, including erosion of arsenic-containing rocks, volcanic eruptions, contamination from mining and smelting ores, and previous or current use of arsenic-containing pesticides. Arsenic is often grouped with metals, but it actually belongs to a class of elements known as metalloids, which share properties of both metals and nonmetals.

Are there different types of arsenic?

There are two types of arsenic compounds in food, water, air and soil: organic and inorganic (together, these are referred to as total arsenic).

Why should I be concerned about inorganic arsenic in rice and water?

Studies of mice and human populations associate long-term exposure of inorganic arsenic *in water* with adverse health effects. Drinking water with more arsenic than the amount that is legally allowed in U.S. public water supplies for many years could lead to health problems, including:

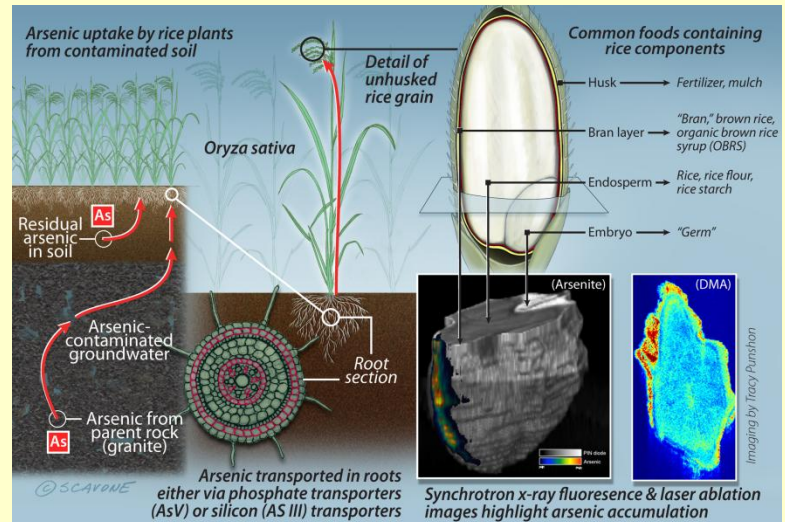
- Thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhea, and liver effects;
- Cardiovascular, pulmonary, immunological, neurological, reproductive, and endocrine effects;
- Cancer of the bladder, lung, liver, and prostate.

Scientists at Dartmouth and other institutions are currently studying the potential health effects of dietary exposure to arsenic. Studies do not currently link consumption of rice containing arsenic to the adverse health effects listed here.

How does arsenic get into food (and rice)?

Plants vary considerably in their ability to accumulate arsenic. Grains, fruits, and vegetables that are grown in or near contaminated soil and groundwater accumulate arsenic. Because both organic and inorganic arsenic are commonly found in soil and groundwater in the U.S., many foods have measurable levels of arsenic, including rice, fruits, vegetables, food and beverage products, fruit juices, and juice concentrates.

The relatively high levels of arsenic in rice are due to: (1) the mobilization and bioavailability of arsenic in the soil that occurs when farmers flood rice fields; and (2) the plant's uptake of arsenic instead of silicon, which the plant uses under normal conditions to strengthen its stems and husks. Arsenic and silicon are chemically similar under the soil conditions found in flooded rice paddies; as a result, arsenic fits into the plant's silicon transporters. As the rice plant grows, the plant integrates arsenic (instead of silicon) into the grain—the part of the rice plant we eat.



How is arsenic in food regulated?

Pursuant to the Food, Drug, and Cosmetic Act and its amendments, the Food and Drug Administration (FDA) has authority to oversee the quality of substances sold as food in the U.S. Under this law, the FDA sets "action levels", which specify minimum amounts of particular contaminants that must be found in a food sample before the FDA will take action to protect consumers. **There is currently no action level for arsenic in rice or juice.** As part of the Total Diet Study (TDS), the FDA has tested for total arsenic since 1991 in a variety of foods, including rice and juice. The TDS evaluates foods as they would be consumed (table-ready), rather than levels on raw commodities or ingredients. In 2012, the FDA released the first analytical results from nearly 200 samples of rice and rice products tested for both total and inorganic arsenic. The FDA is currently considering an action level and it is analyzing additional samples of rice, rice-products, and juice.

How is arsenic in water regulated?

The Safe Drinking Water Act (SDWA) of 1974 directs the U.S. Environmental Protection Agency to issue enforceable drinking water regulations for contaminants that may cause health problems. The enforceable standard for arsenic in public drinking water systems is a maximum contaminant level (MCL) of 10 parts per billion. MCLs are set as close to non-enforceable health goals (the level at which no adverse health effects are expected) as possible, considering cost of removal, benefits, and the availability of treatment technologies. Water systems are not required to comply with the SDWA if they do not have 15 connections or more and serve less than 25 people for more than six months of the year. **Therefore, homeowners with wells are solely responsible for testing and remediating their drinking water.**

How much is 10 parts per billion?

10 parts per billion (ppb) of arsenic in water means that there are 10 parts of arsenic for every 999,999,990 molecules of water. That is roughly equivalent to a few drops of ink in an Olympic-sized swimming pool.

FOR MORE INFORMATION

Toxic Metals Superfund Research Program

<http://www.dartmouth.edu/~toxmetal>

Questions and Answers on Arsenic

<http://www.fda.gov/Food/FoodbornIllnessContaminants/Metals/ucm280202.htm>

Arsenic in Drinking Water

<http://www.epa.gov/safewater/arsenic>

New England Well Water Testing Information

<http://www.dartmouth.edu/~toxmetal/InSmallDoses/welltestinfo.html>

SIMPLE STEPS

To Reduce Your Cumulative Exposure

Step 1: Test Your Well

Arsenic is colorless, odorless and generally tasteless in water. If you drink water from a well, it is your responsibility to test your water for contaminants. Contact your state drinking water agency for names of laboratories that are certified to test drinking water.

Step 2: Remediate Your Well

If your drinking water contains 10 ppb or more of arsenic, purchase a remediation system or find an alternative source of water. Boiling your water will not remove arsenic.

Step 3: Diversify Your Diet

First, eat a balanced diet that includes a wide variety of grains—not only for good nutrition but also to minimize any potential consequences from consuming any one particular food. Second, the UK Food Standards Agency states that “as a precaution, toddlers and young children between 1 and 4.5 years old should not have rice drinks as a replacement for cows’ milk, breast milk, or infant formula.” Third, examine the ingredient list and the weight of the bar. Dartmouth tested 29 bars (multiple brands) of the hundreds of cereal/energy bars on the market. The amount of inorganic arsenic in each bar depends on the size of the bar, the concentration of total arsenic, and the percentage of total arsenic that is in the inorganic form. Eating 2 to 3 of the larger bars (approximately 70 grams) that contain brown rice syrup per day could contribute 10 ppb of inorganic arsenic to your diet. Last, consume fruit juices in moderation; apple, pear and grape juices often contain arsenic and lead.

Step 4: Wash Rice Thoroughly

Research indicates that thoroughly rinsing rice reduces the total arsenic content by ~ 25-30%.

Step 5: Choose Rice Wisely

The FDA and Consumer Reports tests show higher levels of arsenic in brown rice than white rice. Basmati generally contains the least arsenic. There are also higher levels in rice produced in the Southern U.S. states than in rice from California and Asia. Dartmouth tests show arsenic may also be high in products that contain rice syrup and other rice by-products.

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