Arsenic and Rice in Baby Food Supply Chains

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High levels of arsenic found in recent tests of U.S. rice-based baby food products have raised concerns as exposure to inorganic arsenic can have negative impacts on human health, particularly that of children. This Executive Briefing on Trade explores the regulatory measures and supply chain traceability associated with arsenic in domestically sourced or imported rice and rice-based baby food products. Despite the high proclivity of rice plants to take up arsenic, there are no binding measures to monitor and enforce allowable levels of inorganic arsenic in rice and rice-based products in the U.S. market.

Two reports from the U.S. House Subcommittee on Economic and Consumer Policy under the Committee on Oversight and Reform released in February and September 2021 highlighted the high levels of heavy metals (e.g., arsenic) and lack of regulatory measures to enforce U.S. supply chain traceability in rice-based baby food. Based on studies reporting negative impacts of inorganic arsenic[1] on human health and on the neurodevelopment of children exposed in infancy in particular, the findings of the Subcommittee raised concerns among consumer advocacy groups, triggered lawsuits, and led some companies to recall rice-based baby food products. The reports identify rice-based ingredients, in particular organically grown brown rice flour, as containing high levels of inorganic arsenic. Moreover, testing data from the report show that rice ingredients exceeded the company's own specification levels more frequently than other ingredients (table 1).

Table 1. Percentage of sampled ingredient lots that exceed a company's specification for arsenic, by type of ingredient

Ingredient type	Number of lots analyzed	Percentage that exceed arsenic specification
Fruit ingredients	2190	16.4%
Vegetable ingredients	938	11.7%
Bean and grain ingredients	677	8.3%
Rice ingredients	178	19.7%
Other ingredients	132	8.3%
Total	3937	13.6%

Source: USITC analysis of companies that reported arsenic threshold specifications. For links to data, see February 2021 Staff Report.

How is arsenic getting in rice in the first place?

Arsenic is present in soil and water both from natural sources (e.g., minerals) and manmade sources (e.g., farming, mining, and smelting). Plants take up arsenic directly from the soil. Rice is more susceptible to arsenic uptake than most plants because it grows in a flooded anaerobic paddy environment. The use of arsenic-based pesticides to control boll weevils on U.S. cotton crops resulted in lingering deposits of arsenic in some present-day rice paddies. Arsenic has also been found in rice-growing areas in major U.S. rice import source markets in South and Southeast (SE) Asia, likely natural deposits from erosion in the Himalayas as well as mining activities and historic applications of arsenical herbicides. The scientific literature has not come to a consensus on whether arsenic levels in rice are systematically higher in any particular growing region.

Certain production and processing practices can mitigate the presence of arsenic in rice. White rice contains less inorganic arsenic than brown rice, because polishing removes the bran layer where inorganic arsenic accumulates. Some recent studies found arsenic levels at least as high or higher in organically grown rice than conventionally grown rice. An industry source has attributed this to two aspects of organically grown plants. First, organic plants have a lower yield – meaning any arsenic uptake is concentrated in fewer kernels. Second, because organic rice paddies are not drained in order to apply pesticides as many conventional paddies are, the plants are submerged in water for longer periods, prolonging exposure to the anaerobic environment that increases arsenic uptake.

[1] "Inorganic" is a chemical distinction referring to the absence of carbon, not a reflection on production practices. Inorganic arsenic is typically more toxic to humans than organic arsenic.

Why isn't this caught before it gets into baby food? Unlike with pesticides, the U.S. does not set enforceable maximum levels for heavy metals in food.[2] There are federal agencies providing recommendations on safe levels of consumption; the FDA, for example, set guidance suggesting 100 parts per billion (ppb) as a threshold action level for inorganic arsenic in infant rice cereals based on a 2016 risk assessment.[3] Because this guidance is non-binding, there are no tests required of rice growers or processing companies for their final product. Some U.S. baby food manufacturers do perform their own tests and set standards for arsenic in rice and rice product inputs. Those companies responding to the Congressional Subcommittee's information request typically set the allowable level in their rice or rice-derived ingredients at 100 ppb for inorganic arsenic. However, most of these companies do not have a policy of testing of their final baby food products for heavy metals.[4] In FDA tests of rice cereals over the last decade, it reported an improvement in the share of samples at or below the 100-ppb level; 76 percent of all samples met this threshold in 2018 compared to 36 percent of samples from 2011–13.

Where is the rice coming from? It is difficult to say how much of this issue is attributable to imported rice. None of the companies cited in the Congressional staff reports disclosed the sourcing of their rice inputs for their baby food and identifying the region or country of origin of rice inputs into specific U.S. processed rice products based on publicly available data is challenging. In 2019, 14 percent of U.S. milled rice was imported. The countries of South and SE Asia supply nearly 85 percent of U.S. imported rice, with Thailand and India supplying over 80 percent combined (according to industry sources, U.S. rice imports from these countries are mostly high-value jasmine and basmati varieties). Moreover, imports supply about 25 percent of organic rice to the U.S. market. The FDA has never issued an Import Alert for high levels of inorganic arsenic in rice.[5] The EU, which has an enforceable level for inorganic arsenic in rice destined for food for infants and young children set at 100 ppb, sourced a combined 19 percent of its rice imports from Thailand and India in 2019. Regardless of whether rice inputs are imported or domestically produced, arsenic may make its way into rice-based baby food at many points during rice production or processing given the lack of binding U.S. standards for acceptable levels of inorganic arsenic in rice and no mandatory testing at any point along the supply chain for rice products sold in the United States. Further, it is unclear if processing is concentrating or diluting arsenic levels in rice baby food inputs and monitoring levels may be an issue for firms comingling inputs from several sources if testing is only performed on select lots.

Sources: CDC, "Minimal Risk Levels (MRLs),"June 4, 2018; Codex Alimentarius, "Decisions from Day 1," June 27, 2016; Codex Alimentarius, Code of Practice, CXC 77-2017, 2017; Congressional Staff Report, *Baby Foods Are Tainted*, February 4, 2021; Congressional Staff Report, *New Disclosures Show Dangerous,* September 29, 2021; EC, *RASFF 2018 Annual Report*, September 16, 2019; EPA, "Drinking Water Regulations," accessed October 6, 2021; FDA, "FDA Issues Final Guidance," August 5, 2020; FDA, "Import Alert 20-05," June 14, 2021; FDA, *Arsenic in Rice*, March 2016; FDA, *Inorganic Arsenic in Rice*, August 2020; Fendorf, Michael, and van Geen, "Spatial and Temporal Variations," May 28, 2010; Hoang, Prinpreecha, and Kim, "Influence of Mining Activities," April 30, 2021; IHS Markit, Global Trade Atlas, accessed various dates; Menon et al., "Do Arsenic Levels in Rice," July 2020; OJEU, Commission Regulation 2015/1006, June 25, 2015; Olson and Cihacek, "The Fate of Agent Blue," 2020; Pilet, "Lawsuits Piling up against Baby Food," June 23, 2021; Potera, "Food Safety: U.S. Rice Serves," June 2007; USDA, Production, Supply and Distribution, accessed August 13, 2021; USDA, ERS, "Rice Sector at a Glance," January 25, 2021; USDA NASS, 2019 Organic Survey, October 2020.

[2] The EPA has set allowable levels of arsenic in drinking water of 10 ppb. EPA, "Drinking," accessed October 6, 2021.

[3] This guidance allows for arsenic levels exceeding this threshold to be considered by the FDA in its determination of whether a product is "adulterated" under the Food, Drug and Cosmetic Act. In addition, the Agency for Toxic Substances and Disease Registry at the CDC has established minimal risk levels for arsenic of 0.005 mg per kg of bodyweight per day. A minimal risk level is an estimate of the amount of a chemical (usually a chemical associated with a hazardous waste site) a person can intake ingest each day without a detectable risk to health. CDC, "Minimal Risk Levels," June 4, 2018.

[4] As suggested in table 1, there may also be inorganic arsenic in non-rice ingredients in the final baby food product.

[5] Import Alerts are internal agency directives, where the FDA declares it has sufficient evidence to conclude a shipment violates FDA regulations—regulations that include the appearance of an imported product as "adulterated." Import alerts may be issued for companies or countries found to be violative in the past. Shipments from these sources are detained for further inspection or sampling until violations are corrected. FDA, "Import Alerts," May 14, 2019.