What's in your family's rice?

Arsenic, Cadmium, and Lead in Popular Rice Brands—Plus 9 Safer Grains to Try

New tests show popular rice types that parents should limit—and safer choices

Healthy Babies Bright Futures

GREENLATINOS
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GUM MOON WOMEN'S RESIDENCE · ASIAN WOMEN'S RESOURCE CENTER

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ACKNOWLEDGEMENTS

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HBBF would like to thank the following people and organizations for their support:

Anchor Partners: GreenLatinos and Gum Moon Residence Hall

A network of groups and individuals around the country made this study possible by purchasing grains at their local stores and sharing valuable insights into how rice is used in their communities:

Thanks to the **many wonderful volunteers** from the groups listed above who purchased foods for this study or helped to coordinate volunteers:

Lara Aumann	Tracy Gregoire	Lana Mahbouba	Elisabeth Repp
Cassandra Casados	Jennifer Hadayia	Danielle Mangabat	Valentina Rojas
Lucero Contreras	Leonie Hermantin	Micaela Martinez	Alexandra Scranton
Anthony D'Souza	Kaitlyn Joshua	Pam Miller	Analisa Smith
Brenda Franco	Thelisa Lavergne	Thái Nguyễn	Inyang Uwak
Brittany Franklin	Cally Lin	Amanda Pantoja	Vanessa Vassall
Diego Gonzalez	Juan Madrid	Pricille Pernier	Annika Weber

We are grateful for the **guidance and review** provided by Charlotte Brody, HBBF; Paige Whipple Glidden, HBBF; Dr. Margaret Karagas, Dartmouth; Dr. Andrew Meharg, Queens University; Tom Neltner, Unleaded Kids. We are also grateful for the reliable support of Pamela Frank Houndjo, Virginia Organizing.

The study was made possible by a grant from The Freedom Together Foundation (formerly JPB Foundation).

The opinions expressed in this report are those of HBBF and do not necessarily reflect the views of the supporters and reviewers listed above. HBBF is responsible for any errors of fact or interpretation contained in this report.

Report design: Winking Fish

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Rice: A daily staple, a hidden risk

Rice is the most widely consumed solid food in the world and a staple for more than a billion children. Yet for over 25 years, it has also been recognized as a leading dietary source of arsenic, a contaminant associated with health risks that include cancer and harm to the developing brain, including IQ loss.

Significant progress has been made in reducing arsenic levels in **infant rice cereal** over the past decade. The FDA established a limit for arsenic in this cereal; major baby food brands discontinued the use of the most contaminated rice cereal variety (brown rice cereal); at least five states removed infant rice cereal from subsidy programs; and baby food companies reduced the average arsenic level in infant rice cereal by 45%.

However, **no similar action has been taken for rice itself**, even though it — not infant rice cereal — is the **top source of arsenic** from solid foods in the diets of children under two, and a concern during pregnancy, the most critical window for brain development. New tests commissioned for this report found arsenic in **100%** of 145 rice samples purchased nationwide. More than **one in four exceeded the FDA's action level** for infant cereal, a limit above which FDA can consider the cereal to be adulterated. For parents making baby food at home, this means homemade rice cereal could contain arsenic levels considered unsafe if sold in stores.

We found four toxic heavy metals in rice — **arsenic, cadmium, lead, and mercury**. While each contaminant has different health effects, they can contribute to serious risks like cancer, developmental harm including IQ loss, and accumulation in the body over time. Arsenic was found at the highest levels, with cadmium next.

Like many crops, rice absorbs these metals that are naturally present in soil. But rice tends to accumulate significantly more arsenic*, making it a unique and concerning source of exposure. Tests also showed **elevated cadmium** in some samples, and, in a saffron-seasoned rice, **lead levels far above** amounts in other samples.

*(*In this report, "arsenic" refers to inorganic arsenic — the more toxic form and the primary concern in rice — unless otherwise specified.)*

In contrast, the 66 samples of nine alternate grains we tested — including quinoa, farro, and barley — contained **69% less heavy metal contamination**[1] than rice, on average, making them safer substitutes. Arsenic levels were also lower in instant (5-minute) rice, but a high-heat manufacturing step can increase amounts of a particularly toxic form of arsenic[2] in rice products, so we do not recommend it as a safer option. Our tests did identify **three types of rice consistently lower** in total heavy metals: California-grown rice, Thai jasmine rice, and Indian basmati rice — offering better options for families aiming to reduce exposure.

However, the cost of these safer alternatives can be a major barrier for families. On average, the alternative grains we purchased **cost five times as much** as rice ($0.53 vs. $0.10 per serving). And affordability for some of the lowest-arsenic rice varieties is about to worsen. As of April 2025, U.S. tariffs may significantly raise the price of imported rice. Ten percent tariffs are in effect now, and higher tariffs of 36% for Thai jasmine rice and 26% for Indian basmati rice are set to begin in July. Our shoppers also found that rice labeled as California-grown, another lower-arsenic option, tended to cost more in their stores than rice from other regions. For families on tight budgets — or those whose only nearby grocery options are small stores with limited rice varieties — higher-arsenic rice may be the only affordable choice.

Given these cost concerns, it's good news that a **no-cost action is available to families that reduces arsenic in rice by up to 60%: Cooking rice like pasta**. Boiling rice in excess water and draining before serving significantly reduces arsenic content. Two additional steps also help but come at a cost: **Incorporating other grains** such as quinoa, farro, or barley to diversify the diet; and **Choosing rice varieties lower in heavy metals** like California-grown rice, Thai jasmine, or Indian basmati. **Each of these three steps lowers arsenic or total heavy metal exposure from rice by an estimated 30 to 70%.**

Three FDA and state actions could also deliver powerful benefits for families: Set limits (action levels) for both arsenic and cadmium in rice; **Permit labeling** for rice products that meet the infant rice cereal standard — when companies test and publicly share their results; **Require testing and disclosure**, building on California's successful "Food Safety: Baby Food" Act (AB 899) and Maryland's "Baby Food - Toxic Heavy Metals" Act (SB0723). These steps would not only empower families to make safer choices but also create strong incentives for companies to adopt proven best practices to reduce heavy metal levels in their products. States could act in advance of FDA, especially in requiring testing and disclosure. The greatest benefits would go to Asian American, Hispanic, and Latino families, for whom rice is often a daily staple. Rice contributes a significantly larger share of daily arsenic exposure for children in these families, up to seven times more than for other children.

Without FDA or state action, the problem for families could get worse. Some growers are adopting reduced-irrigation methods that help lower arsenic levels — but these methods can **raise cadmium amounts** in rice. At the same time, **arsenic levels are expected to rise** in rice grown in regions experiencing higher average temperatures during the growing season, compounding the risk. Given these prospective changes, action to empower consumer choice and spark industry-wide change is essential.

Rice is a versatile, culturally essential staple. While it contains a mix of heavy metals — most notably arsenic — so do most other foods. What sets rice apart is its relatively high arsenic levels and widespread, frequent consumption. Fortunately, **levels of arsenic and other heavy metal in rice are far lower than those causing acute poisonin**g, such as the lead-contaminated applesauce that sickened at least 22 children in 2023. The health risks aren't from short-term exposure, but from low-level, chronic intake over time - particularly during vulnerable stages like pregnancy, infancy and early childhood.

Arsenic and other heavy metals in rice are linked to cancer, IQ loss, and other cognitive and behavioral deficits. The risk to any one child is small, but the ideal exposure is zero. With the simple steps listed above, **families can continue to enjoy rice while reducing risks.** Just as risk accumulates, so do small choices that protect children's health over the long term.

This first-of-its-kind analysis of total heavy metal content across different rice types, growing regions, and alternative grains highlights two key takeaways: FDA and state action on this issue would provide meaningful protection for families, and, in the meantime, consumers can make informed choices to reduce heavy metal exposure at home. **Our results show that protecting children from arsenic and cadmium in rice isn't just possible — it's essential, and entirely within our reach.**

1 "Heavy metal contamination" or "total heavy metals" indicate the combined amount of inorganic arsenic, cadmium, lead, and mercury.
2 DMMTA, or dimethylmonothioarsenate, formed when the arsenic compound DMA reacts with certain amino acids and B vitamins in rice during high-heat manufacturing steps (Carrijo 2022).

FOR PARENTS:

3 simple changes to lower arsenic and cadmium exposures from rice by up to 69%

Parents play a crucial role in protecting children, especially until rice companies and government health agencies act to reduce heavy metal contaminants. Lowering exposure is possible through simple choices — using safer cooking methods, incorporating alternative grains, and opting for lower-arsenic rice varieties. Making even one of these easy adjustments can meaningfully lower a family's intake of heavy metals from rice.

1 A no-cost solution: Cook rice like pasta to reduce arsenic.

Research shows that cooking rice in 6 to 10 cups of water per 1 cup of rice and draining the excess water before eating can remove a significant amount of arsenic, the most concerning contaminant in rice. This method can even be adapted for rice cookers: partially cook the rice in extra water, drain it, then finish cooking with just enough fresh water. You may need to experiment to find the right amount of water for your preferred rice type.

Up to **60% less** arsenic than rice cooked in just enough water

Tip: If you have time, soak rice for a half hour — or even overnight — and drain before cooking it like pasta, to improve the arsenic loss. Rinsing alone isn't effective.

2 Add variety to your diet with rice alternatives.

Expanding your grain choices can significantly lower your exposure to heavy metals. HBBF testing found that alternatives such as quinoa, barley, couscous, and farro contain much lower total heavy metal levels than rice. These options include grains and pastas which can easily be swapped for rice in your meals.

69% less heavy metals than rice cooked in just enough water

See page 22 for a full list of recommended alternatives and recipes.

3 Choose rice with lower heavy metal contamination.

Some types of rice contain significantly lower total heavy metal levels—primarily arsenic and cadmium—compared to others. Based on HBBF testing and prior studies (e.g., CR 2014 and 2012, FDA 2016), the following varieties are better choices:

Lower in total heavy metals:

- California rice – Calrose, Sushi, Jasmine, White
- Jasmine rice (Thailand)
- Basmati rice (India)

32% less heavy metals than other rice types on average

Higher in total heavy metals:

- White rice grown in the Southeast U.S. or "USA"
- Brown rice
- Arborio rice (risotto) from Italy

May be higher in other contaminants of concern:

- Precooked rice - Instant (5-minute), Parboiled (10-minute), and Ready-to-Heat.
- Concerns: Higher levels of especially toxic arsenic types, and packaging chemicals.

If you eat brown rice, choose brands grown in California. These tend to have lower arsenic and cadmium levels.

Balance the plate: Pair rice with iron-rich nutritious foods.

Variety is key to a healthy diet. Iron-rich foods are especially important when serving white rice cooked like pasta, since boiling and draining can wash away the iron that's added during enrichment. Many babies don't get enough iron—and their needs increase between 6 and 12 months—so talk to your pediatrician about nutrition and iron-rich foods.

For variety, stand-out options include:

- Iron-rich foods – Lean red meat, poultry, beans, lentils, eggs, green vegetables, fresh and dried fruits.
- Whole grains – Aim to make at least half the grains you serve whole grains, like quinoa, barley, and farro (note: pearled grains and white rice are not whole).
- Foods rich in calcium, zinc, B vitamins and vitamin C – Many nutrients help reduce the body's absorption of contaminants or speed up their excretion. Find them in foods like lean meat, yogurt, cheese, leafy greens, broccoli, beans and lentils, citrus fruits, strawberries, and peppers.

Foods to skip - Rice-based processed foods are often high in arsenic that can't be boiled and drained away like arsenic in rice itself, including:

- Rice-based snacks
- Rice cakes
- Foods sweetened with brown rice syrup including some formula brands and cereal bars

The study included a wide range of grain varieties and brands purchased from stores across the country

4
toxic heavy metals tested

211
containers

105
brands of rice and other grains

Ben's Original · DIXIE LILY · GOYA · TRADER JOE'S · LUNDBERG FAMILY FARMS · Mahatma AMERICA'S FAVORITE RICE

and 99 other brands

10
forms of grain

RICE AND BROWN RICE

WHEAT-BASED: **COUSCOUS, BULGUR, FARRO**

BUCKWHEAT

AMARANTH

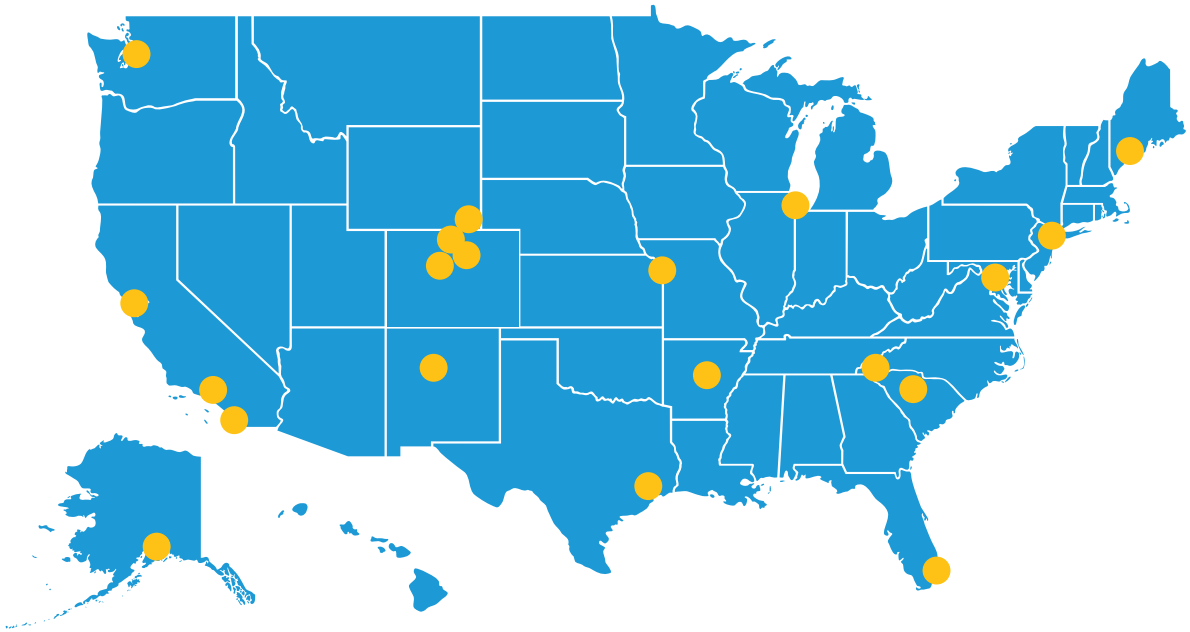
BARLEY

QUINOA

MILLET

SPELT

20
metro areas for sample purchase



New York, NY
Washington, DC
Little Rock, AR
Franklin, NC
Boulder, CO
Denver, CO
Leadville, CO
Chicago, IL
Los Angeles, CA
Houston, TX
Chapin, SC
San Diego, CA
Kansas City, KS
Anchorage, AK
Cheyenne, WY
Seattle, WA
San Francisco, CA
Topsham, ME
Miami, FL
Albuquerque, NM

Overview of major findings

The unchecked threat of arsenic and cadmium in rice

Rice is the most widely consumed solid food in the world and a dietary staple for over a billion children (FAO 2024, USDA 2025a). However, for more than 25 years, it has also been recognized as a major source of arsenic in the diet. Wide-ranging research has confirmed its presence in rice from every major growing region worldwide, including the brands and varieties sold in the U.S.[3] In response, leading experts have called for action — for years now — urging health agencies to limit arsenic levels and mitigate health risks (e.g. Meharg 2014, CR 2014).

New tests of 145 rice samples from retailers nationwide — including a wide range of U.S.-grown and imported varieties — reveals that, despite decades of awareness, rice sold in the U.S. remains widely contaminated with arsenic. Testing commissioned by Healthy Babies Bright Futures (HBBF) detected arsenic in 100% of samples, with more than one-fourth exceeding the federal limit set for infant rice cereal. No such limit exists for rice itself — the bags and boxes of rice served at family meals — despite it being widely consumed by infants and toddlers. Additionally, cadmium was found in all but one sample, with some showing elevated levels.

The contaminants are associated with increased risk of cancer, neurological harm during early development, including IQ loss, and other health concerns (EPA 2025a, Hoffman 2024). Despite the potential risks, we found no evidence of significant progress to reduce the amounts found in rice sold in the U.S.

Instead, efforts over the past 13 years have focused on infant rice cereal. Key actions include the U.S. Food and Drug Administration (FDA) establishing an arsenic limit for infant rice cereal (FDA 2020), at least five states removing it from their Women, Infants, and Children (WIC) food subsidy program[4], and all major baby food companies discontinuing brown rice infant cereal due to its higher arsenic content. Stricter sourcing by baby food manufacturers has also led to a 45% reduction in arsenic levels in infant rice cereal (HBBF 2022).

This progress has benefited babies, but our test results support a focus extending beyond cereal to rice itself. For children up to age 2, rice — not infant rice cereal — is the leading source of arsenic exposure from solid foods (Abt 2025). This is especially true for those who eat foods made at home, or packaged foods from outside the baby food aisle, which contribute twice as much arsenic to a baby's diet as commercial baby food (Abt 2025). Rice is also a primary concern in the increasingly popular practice of baby-led weaning, where infants are offered many of the same foods, including rice, as the rest of the family.

Importantly, the progress made for infant rice cereal does not help pregnant women who eat rice. Pregnancy is the most critical window for protecting children from arsenic's neurodevelopmental effects, including IQ loss (EPA 2025a).

3 See, for example: Yost 1998, Schoof 1999, CR 2012 and 2014, FDA 2016, Meharg 2019.
4 Alaska WIC 2020, Colorado WIC 2023, Hawaii WIC 2024, Oregon WIC 2022, Washington WIC 2025

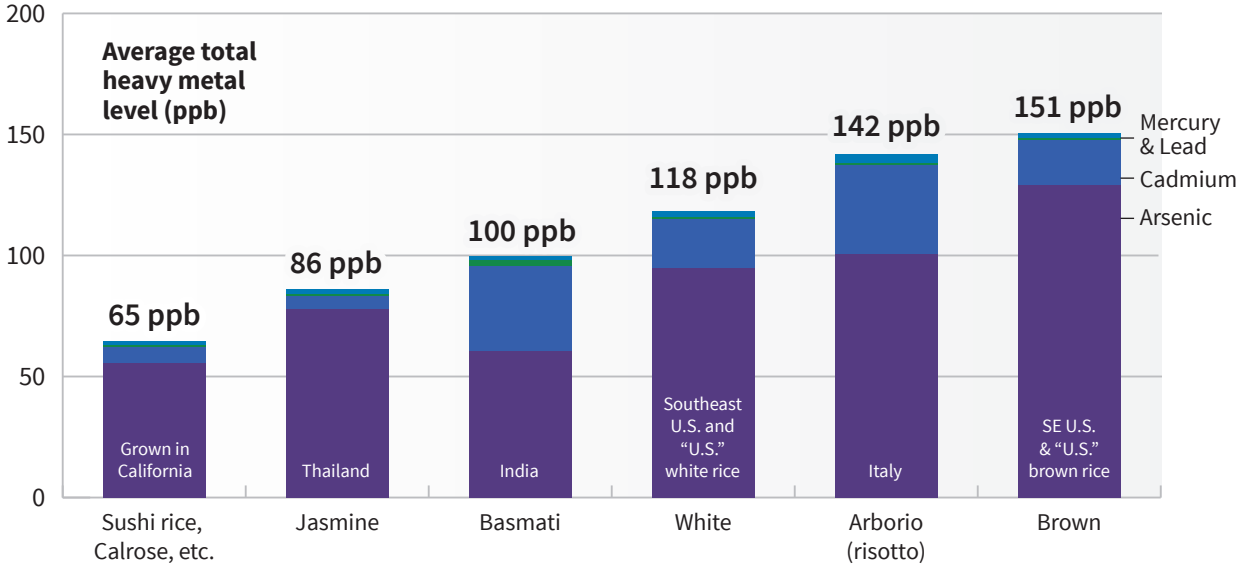
New tests of 145 rice samples show an ongoing risk that varies by rice type and origin

Our tests detected four toxic heavy metals[5] in rice — arsenic, cadmium, lead and mercury — with arsenic dominating and cadmium second in importance. We expected arsenic levels to vary by rice variety and growing region, as previously reported (CR 2014). But we also wanted to know how the *total* metal[6] content compares across rice varieties, since all four metals, not just arsenic, can pose risks to a child's neurological development. And we compared rice to 9 substitute foods that include quinoa, barley, couscous, and other grains. We included 66 of these samples in our testing initiative.

Key findings from testing[7]:

- **Highest total metal levels:** Brown rice grown in the Southeast U.S. or labeled as "Grown in the USA" contained the highest average levels of heavy metals. Levels in arborio (risotto) rice grown in Italy were nearly as high.
- **Elevated heavy metal levels in U.S. rice:** White rice grown in the Southeast or "USA" showed consistently higher levels of heavy metals, primarily arsenic, than rice grown in California.

Figure 1. HBBF tests of rice samples: Heavy metal levels vary by rice type and growing region



Note: Total heavy metal level shown reflects the average amount of inorganic arsenic, cadmium, lead, and mercury measured in samples of each rice type.

- **Lower heavy metal levels:** Rice grown in California, as well as Thai jasmine rice and Indian basmati rice, generally contained lower heavy metal levels than other varieties tested.
- **Notably higher cadmium levels:** Basmati rice from India and arborio rice from Italy had the highest average cadmium levels.
- **Concerning lead contamination:** A saffron-seasoned rice contained lead levels up to 32 times higher than the average lead content in other samples.
- **Precooked rice findings:** Instant (5-minute) rice had significantly lower total metal levels[8], but recent studies find that an unusually toxic form of arsenic may be present instead, formed during a high-heat manufacturing step (Colina Blanco 2024, Yadav 2024).

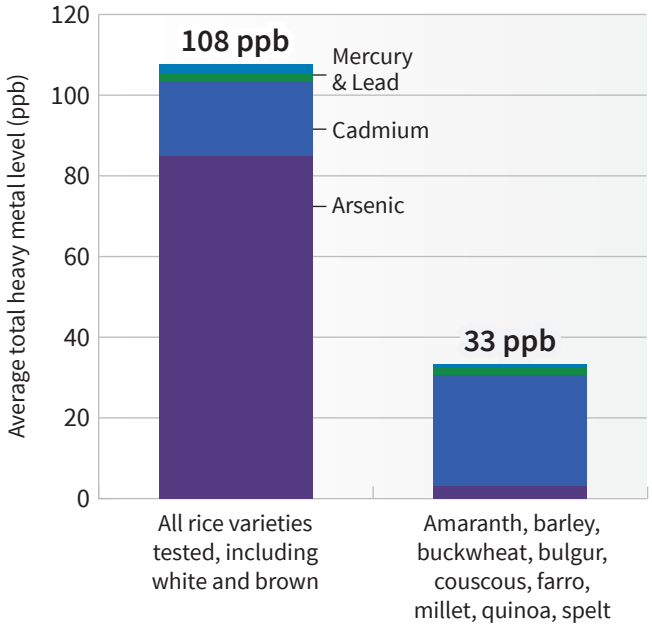
5 In this report, "heavy metal" refers to all four contaminants tested in rice—arsenic (total and inorganic), cadmium, lead, and mercury. Technically, arsenic and mercury are metalloids, not heavy metals. For this reason, FDA refers to these contaminants collectively as "toxic elements." We use "heavy metals" to remain consistent with parent-facing resources, including AAP (2025), Cleveland Clinic (2024), Harvard Medical School (2021), FDA (2025).

6 In this report, the term "total metal" or "total heavy metal" indicates the combined concentrations of inorganic arsenic, cadmium, lead, and mercury. For each rice variety or grain type, the term represents the average total heavy metal content across all available samples. This metric serves as a proxy for cumulative risk, given the lack of FDA analysis on the relative developmental risks posed by these contaminants. Although arsenic, cadmium, lead, and mercury frequently co-occur in rice and other foods commonly consumed during pregnancy and early childhood, the FDA has not yet evaluated their relative or cumulative risk. The bar charts above, which display total heavy metal levels, also highlight tradeoffs in heavy metal composition—particularly between arsenic and cadmium—across different rice varieties. See page 20 for additional details.

7 Some rice varieties were tested in more limited numbers and are not included in the variety-specific findings above. See results for these additional samples in Figure 3 and Appendix A.

8 The current study found lower average heavy metal concentrations in a limited number of precooked rice samples, consistent with findings from a larger sample analyzed by the FDA (FDA 2016).

Figure 2. HBBF tests of 211 samples: Rice has 3 times more heavy metals than other grains



- **Rice alternatives:** On average, non-rice grains contained 69% less heavy metal levels than the rice samples tested. Rice contained 28 times more arsenic than alternative grains, while alternative grains contained 1.5 times more cadmium than rice.[9]

This first-of-its-kind analysis of total metal content across different rice types, growing regions, and alternative grains highlights two key takeaways: FDA and state action on this issue would provide meaningful protection for families, and, in the meantime, consumers can make informed choices to reduce heavy metal exposure at home.

Economic barriers to safer rice: The need for FDA action

FDA action is especially critical for two economic reasons: alternative grains are significantly more expensive than rice, and new tariffs will increase the cost of some of the safest rice varieties, limiting access for families.

The cost of alternate grains. Rice is an affordable dietary staple. The alternative grains in our study that can help reduce heavy metal exposure — such as quinoa, farro, and barley — cost, on average, five times more per serving than rice. According to Statista (2024), a serving of rice costs just $0.10, while our shoppers paid an average of $0.53 per serving for alternative grains. While some families can afford this switch, many cannot, underscoring the need for FDA action to lower arsenic and cadmium levels in rice.

Tariffs on low-arsenic rice. As of April 2025, new U.S. tariffs will increase the cost of some of the lowest-arsenic rice varieties that help families reduce heavy metal exposure. Jasmine rice grown in Thailand and basmati rice from India are now subject to a 10% tariff which will increase to 36% and 26% for Thai and Indian rice, respectively, in July 2025 (Kendall 2025, SSRiceNews.com 2025). As the market adjusts and prices rise, families on tight budgets may be forced to purchase rice from other regions with higher arsenic levels, further underscoring the need for FDA action.

9 Average levels of inorganic arsenic in our study were 84.8 ppb in rice and 3.1 ppb in alternate grains. Average cadmium levels were 18.8 ppb in rice and 27.5 in alternate grains. Inorganic arsenic in alternate grains was estimated as 70% of total arsenic.

FDA and states hold the keys to change with these 3 actions

The FDA and states hold the power to reduce arsenic and cadmium in rice and protect the health of babies and pregnant women. Three critical steps can make a significant difference:

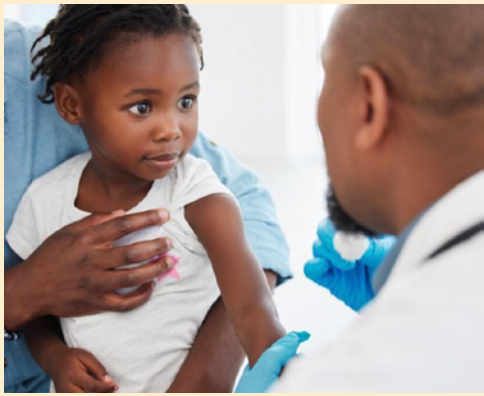
- **Set limits on arsenic and cadmium in rice.** FDA should establish caps (action levels) for these toxic metals in rice sold in the U.S. Rice that exceeds the agency's current action level for infant rice cereal (100 ppb inorganic arsenic) — or contains cadmium at levels well above typical amounts — should not be allowed on store shelves. Given that rice is commonly consumed by babies and during pregnancy in critical developmental windows, this protection is essential.

- **Permit the use of this claim on rice packaging: "Meets FDA health guidelines for infant rice cereal."** To qualify, companies would test representative samples of each lot, meet FDA's 100 ppb action level for arsenic in infant rice cereal, and post the results online. This simple label would help parents avoid rice with excessive arsenic levels, found in more than one-fourth of the samples tested by HBBF.
- **Require testing and public posting of results.** Some companies already test their products and publish results for commercial baby food to comply with California's AB 899 (the "Food Safety: Baby Food" Act) and Maryland's "Baby Food - Toxic Heavy Metals" Act (SB0723). States could build on this model, requiring all rice sold in the U.S. to undergo routine testing, with publicly accessible results by lot number, to empower parents and ensure accountability.

We also urge the federal government to issue clear guidance on best practices, to help growers, suppliers, and rice manufacturers adopt proven strategies that minimize arsenic and cadmium uptake in rice (e.g., Schaefer 2020). This guidance should be regularly updated to reflect the latest research and drive continuous industry-wide improvements. As best practices lead to progressively lower levels of heavy metals in rice, FDA can incrementally lower arsenic and cadmium limits to better protect public health.

How concerned should parents be?

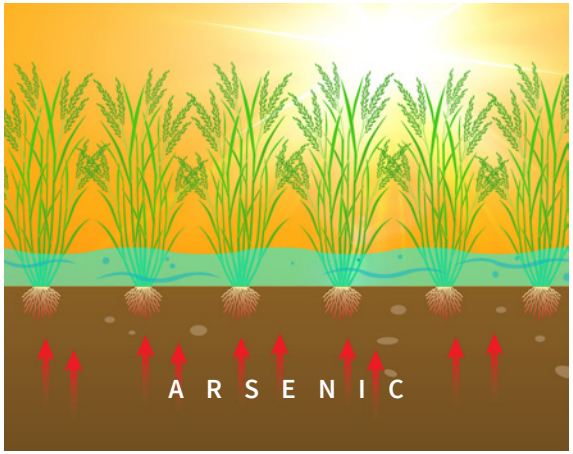
The health concern with toxic heavy metals in rice lies not in short-term, acute harm, but in chronic, low-level exposures that accumulate over time—especially during critical developmental periods like pregnancy, infancy, and early childhood. Rice is just one of many foods that contains heavy metals. In 2022, HBBF testing found these contaminants in 94% of both commercial and homemade baby foods (HBBF 2022). But rice stands out—not just because it tends to have relatively high arsenic levels, but also because it's consumed frequently, resulting in significant cumulative exposure for individuals and the population as a whole.



No amount of these mixtures of heavy metals is known to be safe. Collectively, they are linked to cancer and neurodevelopmental harm, including IQ loss and cognitive and behavioral issues (e.g., EPA 2025, FDA 2016, Hoffman 2024). The risk to any one child is relatively small, but the ideal amount of exposure for any child is zero. Repeated low-level exposures can have lasting effects and become especially significant when considered across the entire population. This is why the FDA has already acted to limit arsenic in infant rice cereal. Now, it should extend those protections to all forms of rice. In the meantime, parents can take steps to reduce their children's exposure. Protecting children's health over the long term doesn't always require big changes—just as small risks add up over time, so can small actions, taken consistently.

FDA action will incentivize industry-wide change

Minimizing arsenic and cadmium in rice has proven to be tricky. Rice plants naturally absorb heavy metals from soil and water, especially arsenic, accumulating higher levels than any other staple crop. Researchers and growers have been experimenting with ways to adjust irrigation, minimizing water use to reduce arsenic levels, but those methods increase cadmium in the rice grain (Carrijo 2022). Just as problematic, recent studies show that higher temperatures during the growing season can increase arsenic uptake in rice. This means that rice fields in regions where seasonal temperatures are rising, and unusually hot days are increasing in frequency, could see their crop's arsenic levels rise as well (Farhat 2019, 2021).



The persistent issue of arsenic and cadmium in rice is especially consequential for Hispanic, Latino, and Asian American families, **for whom rice is often a daily staple.** Federal data shows that for children ages 0-2 in these communities, rice contributes a significantly larger share of daily arsenic exposure, up to seven times more than for other children (Abt 2025). Asian American families, in particular, consume more rice than other groups, with one in six eating rice twice a day or more (FDA 2016).

Fortunately, promising methods for reducing contaminants in rice are emerging across both farming and manufacturing — and many can be adopted now to lower arsenic and cadmium levels in rice and rice-based foods, even before the FDA sets limits. For example, food manufacturers can significantly reduce arsenic levels in rice-based prepared foods — such as infant formulas and snacks — by precooking the rice in continuously refreshed water, similar to percolation methods (Carey 2015). Alternatively, around 80% reduction of arsenic and cadmium can be achieved by presoaking rice in two common food additives — citric acid and calcium carbonate (Pogoson 2021). On the agricultural side, recent research suggests that strategically timing field wetting and drying cycles, along with careful management of soil moisture, fertilizer application, and other factors could help growers minimize both cadmium and arsenic levels, while also reducing emissions of major climate-warming gases[10] (Loaiza 2024, Islam 2018, Carrijo 2022, World Bank 2022).

10 Rice production accounts for an estimated 10% of global emissions of methane, a potent greenhouse gas, from anthropogenic sources (World Bank 2022), making emission reductions critical in climate change mitigation strategies.

IN DEPTH ANALYSIS:

Seven key insights from new tests of rice and other grains

HBBF and a national volunteer network of 16 other non-profit organizations purchased rice and other grains from stores in 20 metropolitan areas across the country. Shoppers purchased foods from 53 retail chains or independent stores - supermarkets, dollar stores, superstores, local markets - and online retailers. Several organizations bought samples from small, local Hispanic and Asian markets carrying brands not available in mainstream stores, including bulk samples often purchased by families for whom rice is a daily staple.

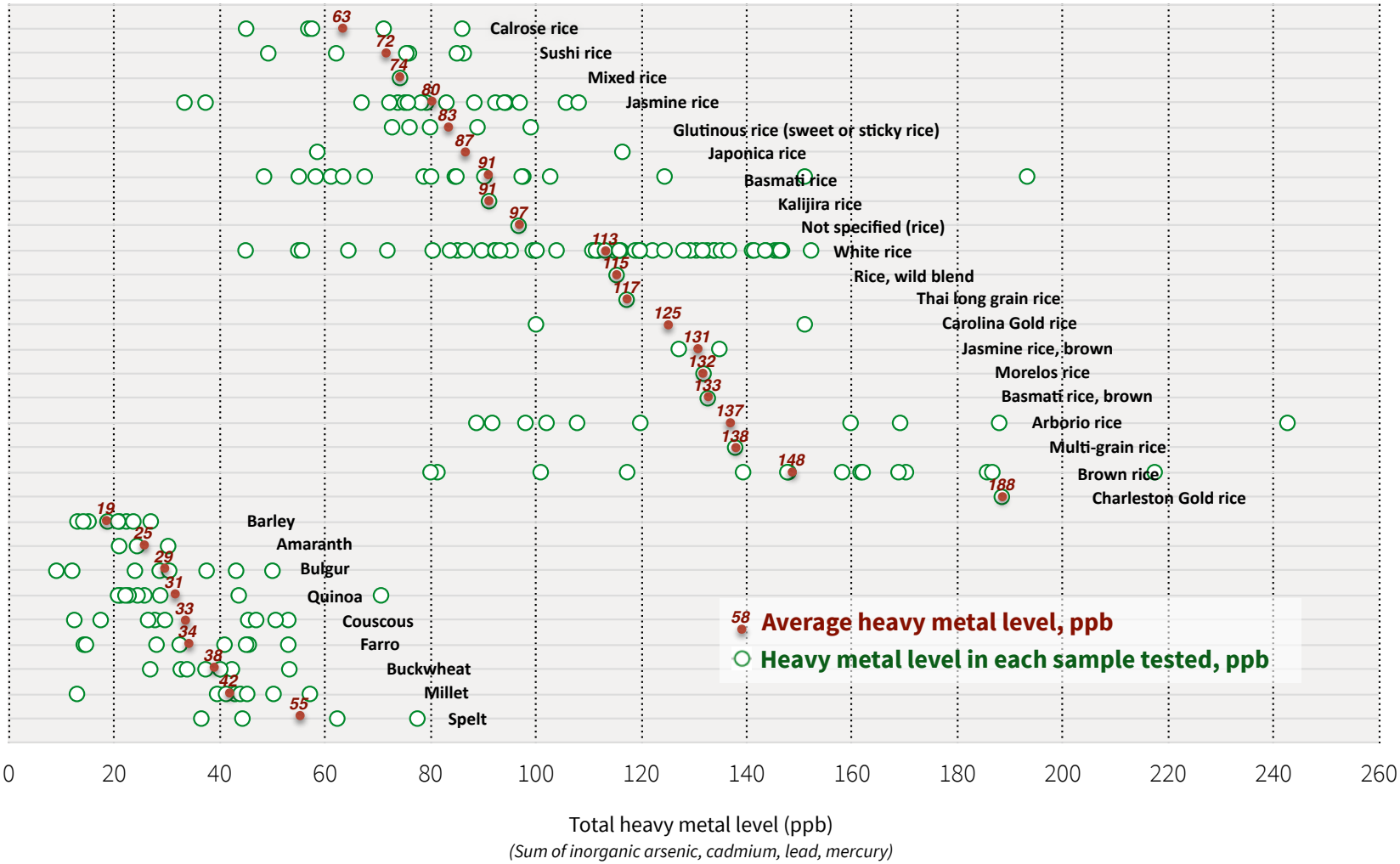
We commissioned a nationally recognized laboratory with expertise in heavy metal analysis, Brooks Applied Labs in Seattle Washington, to test for four toxic heavy metals — arsenic, lead, cadmium and mercury — in the 211 grains included in this study: 145 rice samples and 66 samples of other grains, including quinoa, couscous, barley, farro, and others. We also commissioned this lab to test all rice samples for inorganic arsenic — the most toxic form of arsenic commonly found in rice. Non-rice samples contained lower arsenic amounts and did not require this follow-up testing.

Here we highlight 7 key insights.

#1 - Heavy metals were found in every brand of rice tested– levels varied widely by rice type and growing region

Our tests build on 25 years of research confirming the presence of arsenic in every rice variety from every growing region worldwide. We detected arsenic in 100% of the 145 rice samples tested, including both U.S.-grown and imported varieties. In addition to arsenic, we found three other toxic heavy metals — cadmium, lead, and mercury. Cadmium was nearly as prevalent as arsenic, present in all but one sample. Lead and mercury were less common, each detected in over one-third of the samples (34% and 39%, respectively).

Figure 3. Total heavy metals in 211 store-bought bags and boxes of rice and alternate grains



Arsenic was the most concentrated of all four contaminants, exceeding the levels of other metals in all but seven samples, where cadmium was higher. On average, arsenic made up 79% of the total heavy metal content in rice, followed by cadmium at 17%, and lead and mercury at around 2% each. But lead and mercury stood out in some samples, with amounts ranging up to 36 ppb for lead and 9 ppb for mercury. Contaminant levels varied by rice type and region, as shown in Figure 1 (page 7), consistent with findings from prior studies (e.g., Consumer Reports 2014). This variation offers families options to reduce exposure: lower-arsenic choices include California-grown rice, Thai jasmine rice, and Indian basmati rice.

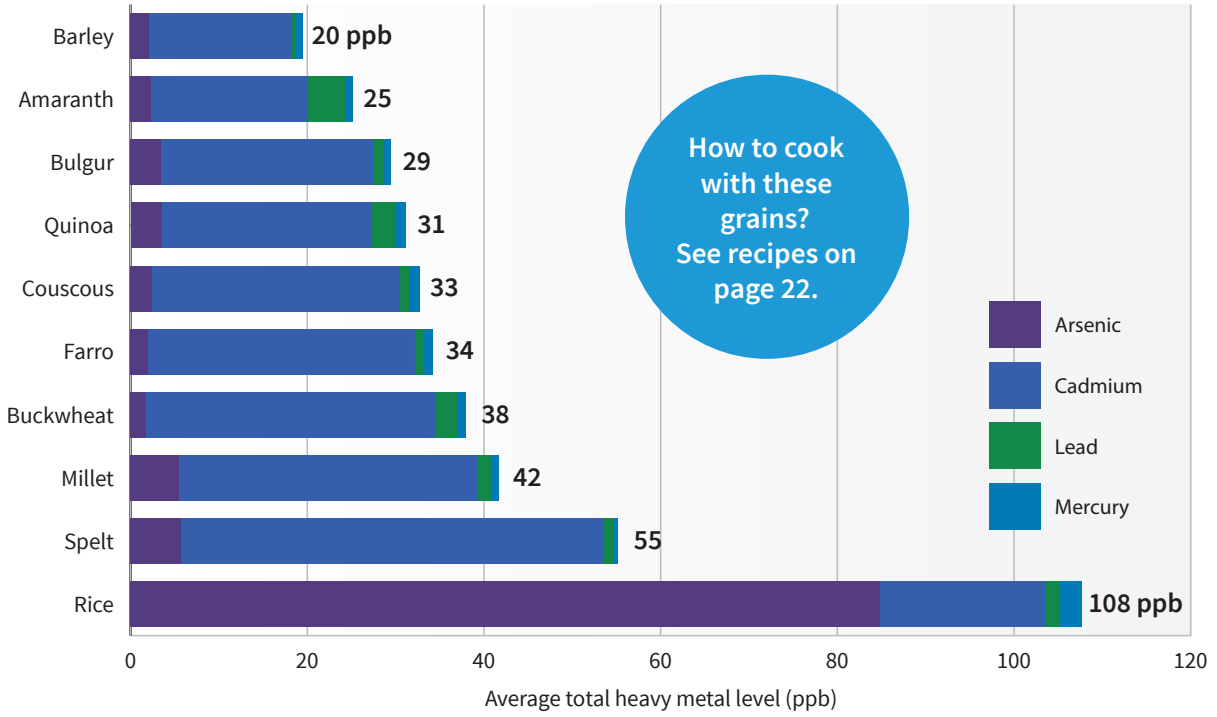
#2 - Alternative grains have significantly lower total heavy metal contamination than rice

HBBF tested samples of nine rice alternatives, including quinoa, couscous, and barley. On average, these grains contained only one-third the total heavy metal levels found in rice.

A total of 66 samples were analyzed, with 7 to 10 samples per grain type, except for amaranth and spelt, which had fewer. Across all non-rice grain types, total heavy metal levels were typically substantially lower than those in our 145 rice samples. Rice averaged 3 times more total heavy metals than alternate grains (108 ppb versus 33 ppb), driven by higher arsenic levels. On average, rice contained 28 times more arsenic than alternate grains — while alternative grains had more cadmium, 1.5 times more than rice.

Our results indicate that adding a variety of other grains to the diet besides rice can significantly lower total heavy metal exposures.

Figure 4. HBBF tests of 211 grain samples: Rice has 2 to 5 times more heavy metals than other grains, on average



About the rice alternatives we tested

Our study included 9 alternate grain types, including a number of whole grains that are generally more nutritious than refined grains and also low in arsenic. Shoppers found that about half of the grain varieties were readily available in major grocery chains:

Whole grains: These include their nutritious outer layers, the germ and bran. Recommended as a dietary staple over refined grains. Most samples we tested were whole grain, including products labeled "hulled" for which only the outer hull has been removed.

Refined grains: The nutritious germ and bran layers have been milled off. Refined rice (white rice) is often enriched before packaging, with B vitamins and iron added to replace lost nutrients. The refined grains we tested included "pearled" varieties, for which both hull and bran are removed, none of which were enriched, and couscous, which is usually made from refined wheat flour (sometimes enriched), though whole-grain versions are also available.

Gluten free: Four of the grains tested are naturally gluten-free — amaranth, buckwheat, millet, and quinoa.

Readily available at major grocery chains: quinoa, farro, and couscous.

Less common, available in only some chains: millet, bulgur, buckwheat, and barley.

Hard to find in stores but available online: spelt and amaranth.

Cost per serving: The average cost of a serving of rice is $0.10 (Statista 2024). In our study, shoppers paid an average of $0.53 per serving for alternative grains purchased in stores, while online purchases cost even more, 70% more than store prices. The most affordable options — barley, bulgur, and millet — averaged under $0.40 per serving, with some brands available for less than $0.20 per serving.

See page 22 for cooking tips and recipes.

#3 - Precooked rice: Convenience comes with potential risks

Precooked rice offers a quicker cooking time, and one type, instant (5-minute) rice, has been recommended as a way to reduce arsenic exposure (e.g., EWG 2025). According to FDA testing, instant rice contains 38% less arsenic than regular raw rice (FDA 2016). HBBF's limited testing found an even greater reduction of 48%.

Despite the convenience, precooked rice comes with notable concerns. **Instant rice** may contain higher levels of an unregulated form of arsenic (dimethylmonothioarsenate, or DMMTA) found to be unusually toxic in recent laboratory tests (Carrijo 2022). **Parboiled rice** often retains higher inorganic arsenic levels. **Ready-to-heat rice** can contain undisclosed chemicals leaching from plastic packaging. Given these risks, none of these precooked rice options are recommended for regular consumption.

Precooked rice types: Risks to consider

Instant (5-minute) rice: Instant rice undergoes partial cooking, drying, and puffing, a process that reduces inorganic arsenic levels while allowing for quick preparation at home (Fink 2023, FDA 2016, Yadav 2024). However, the high heat used in puffing can trigger the formation of DMMTA, an unregulated arsenic compound that results from arsenic binding with certain nutrients in rice. Studies suggest that DMMTA levels may continue to rise during storage. Though it appears to be common in puffed rice, standard arsenic testing methods have missed this compound, mistaking it for another less toxic form of arsenic.

Initial research indicates that DMMTA could be three times more toxic than the inorganic arsenic typically associated with health risks in rice. While recent studies have focused on DMMTA in puffed rice products like rice cakes (Colina Blanco 2024), a high temperature puffing process can also be used to produce instant rice (Yadav 2024, Fink 2023). Study authors warn that "from a food safety perspective, this [DMMTA] likely represents an increased risk" compared to conventional rice (Colina Blanco 2024).

Parboiled (10-minute) rice: Not a reliably safer option. Parboiled rice is traditionally partially boiled in the husk before drying and polishing (Fink 2023). The FDA has noted that this process alters the rice starch in a way that may increase arsenic retention and explain the higher levels the agency found in parboiled rice (FDA 2016). Research suggests an alternative method — removing the husk before boiling — can reduce arsenic levels by 25% (Rahman 2019, Meharg 2025). However, consumers have no way of knowing which method was used for the parboiled rice available in stores, making it an unreliable choice for reducing arsenic exposure.

Ready-to-heat rice: No reduction in arsenic expected. This fully cooked rice is manufactured by sealing raw rice in a container with water and any flavorings, then steam-cooking it under pressure (Fink 2023). Because the arsenic stays trapped in the container, there is no opportunity for removal. Additionally, undisclosed additives present in the container material may leach into the rice during cooking and heating (Muncke 2020).

For those looking to minimize arsenic exposure and health risks, precooked rice is not a reliable choice. Industry disclosure of arsenic levels and production methods would reduce the hidden risks and help consumers make informed decisions.

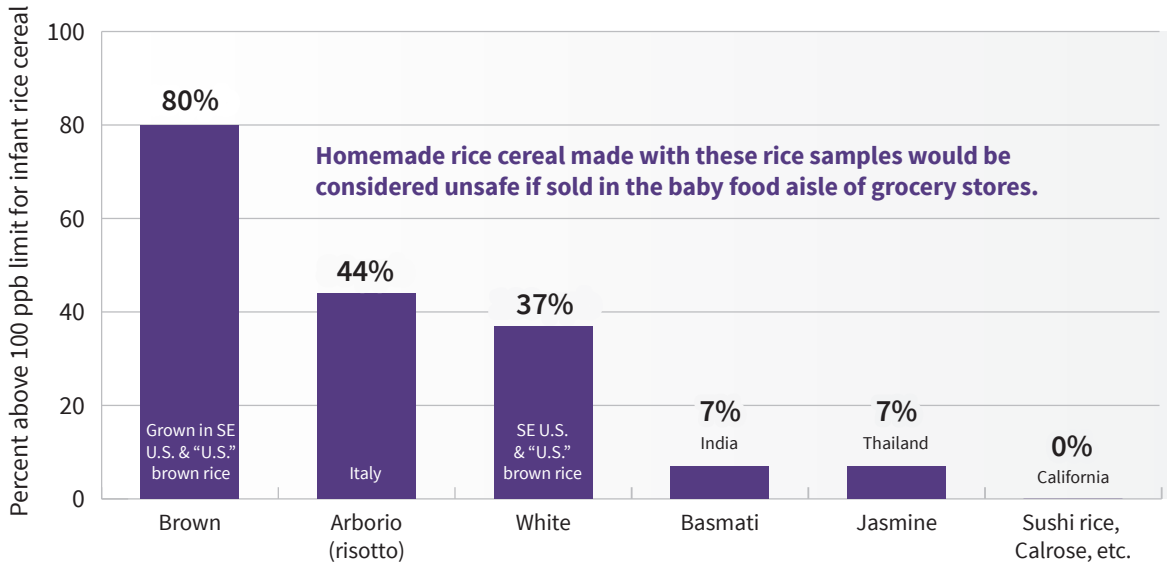
#4 - Many rice brands we tested exceed health benchmarks for heavy metals

Although no legal limit exists for heavy metals in rice, our testing found that many rice samples exceeded federal and state health-based benchmarks.

More than one in four rice samples (28%) contained arsenic levels **above the FDA's 100 ppb "Action Level"** for infant rice cereal (FDA 2020). The FDA can deem products adulterated if they exceed this threshold (FDA 2018). For parents, this means that homemade rice cereal could contain arsenic levels high enough to be considered unsafe if it were sold in stores.

Just 0.6 servings of rice per day would push a 6-month-old infant over the **EPA's new health-based Reference Dose (RfD) for arsenic** meant to protect the developing brain (EPA 2025a).[11] However, arsenic exposure isn't limited to rice — most foods contain some level of arsenic, and drinking water is often contaminated as well.

Figure 5. HBBF tests of rice samples: Inorganic arsenic frequently exceeded the FDA's safety threshold for infant rice cereal



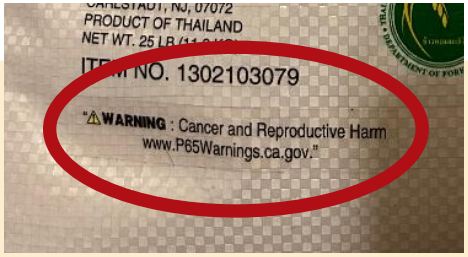
11 Calculation based on: EPA's neurodevelopmental reference dose of 0.015 ug/kg-d; rice serving size for infant of 15 grams, consistent with infant rice cereal labels; infant body weight of 7.7 kg (6-month typical weight of 17 pounds); and average level of arsenic in rice of 85 ug/kg, HBBF's study-wide average.

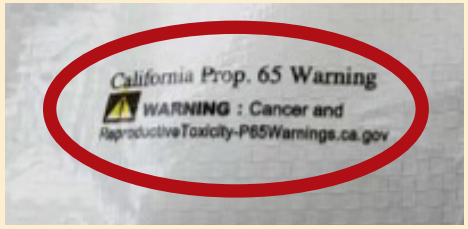
HBBF found arsenic in 73% of baby foods tested, meaning exposure builds up throughout the day from multiple sources (HBBF 2019). When considering these combined exposures, even fewer rice servings would be enough to push a baby above the EPA's limit.

Warning labels on rice with high arsenic levels could help consumers avoid riskier products during pregnancy and early childhood — times when developing brains are especially vulnerable. For a two-person household, a 25-pound bag of rice could last up to four months, spanning much of a pregnancy and key periods of brain development. In such cases, a warning label — like those required under California's Proposition 65 for certain products — would be a critical safeguard.

Two rice products we purchased during our investigation carried **California's Proposition 65 warnings**, which inform consumers about chemicals known to cause cancer or reproductive harm (OEHHA 2023). However, these warnings may have been unnecessary. A consequential 2024 court decision allows companies to avoid labeling by averaging test results across multiple lots and assuming average consumption rates, among other relaxed standards (Steptoe 2024). As a result, even rice with high heavy metal levels may not carry a warning — leaving frequent rice eaters and bulk buyers, including many Asian, Latino, and Hispanic families, unaware of potential risks.

The Proposition 65 health warning on rice purchased for this study:
H Mart Thai Hom Mali Jasmine rice (from an H Mart in San Francisco) and Three Ladies Jasmine Rice Extra Super Quality (from 25th Irving Market in San Francisco). Many rice containers would bear this warning if the standard applied to individual rice containers and to families that eat rice frequently.





#5 - Some rice samples had unusually high heavy metal levels

Every rice sample tested by HBBF contained toxic heavy metal residues, but certain rice samples stood out with significantly elevated concentrations. The individual containers we tested may not reflect a brand's average heavy metal levels over time. However, they do represent what a shopper could have purchased on any given day — potentially serving it to their family across multiple meals. These findings reinforce the need for stricter standards, better industry oversight, and greater consumer awareness.

Highest lead level found in saffron-seasoned rice.

Lead is typically found at relatively low levels in rice, but Dixie Lily's Parboiled Yellow Rice with Saffron contained surprisingly high amounts — the highest among all samples tested. Both samples analyzed showed elevated lead levels, with the highest measurement reaching 36 ppb — 32 times the average across all rice samples and five times higher than the next highest sample from another brand. Notably, the two tested Dixie Lily samples came from different production lots and best-by dates separated by 3 months, suggesting an issue that may extend beyond an isolated incident.

Lead-contaminated saffron may be the culprit (Ishida 2022). The FDA has previously uncovered cases of economically motivated adulteration in the spice industry, where companies add lead and other contaminants to enhance color or volume (FDA 2024a). A stark example occurred in 2023, when lead-contaminated cinnamon in applesauce sickened at least 22 children, causing symptoms such as headaches, nausea, vomiting, and anemia (FDA 2024b, CDC 2023). Notably, these products contained at least 40 times more lead than the saffron-seasoned rice we tested (FDA 2024c). But as no safe level of lead in children's blood has been identified (CDC 2023), rice companies should do all they can to prevent these unnecessary exposures.

These incidents highlight the urgent need for regular ingredient testing. Companies must ensure their products are free from excess contamination to prevent these avoidable health risks.

Highest arsenic levels.

Brown rice generally contains more arsenic than white rice, so it's no surprise that a brown rice sample had the highest arsenic level from among our tested rice samples—First Street Long Grain Brown Rice, purchased at a Smart & Final in Los Angeles. At 201 ppb, its inorganic arsenic concentration was twice the FDA's action level set for infant rice cereal. Altogether, 28% of rice samples tested exceeded 100 ppb inorganic arsenic, and four of those exceeded 150 ppb:

- First Street Long Grain Brown Rice
- Rouses Market Brown Rice Long Grain
- Seggiano Organic Arborio Risotto Rice
- Mahatma Brown Whole Grain Rice

Highest cadmium levels.

Although rice tends to have lower cadmium levels than other grains, three samples stood out with elevated concentrations—above 100 ppb, and higher than amounts in any alternative grain tested:

- Signature Select Arborio Rice
- Kroger Basmati Rice
- Andy's Charleston Gold Rice

Many children are exposed to cadmium in food at levels above health standards. FDA scientists found that more than half of young children ages 1 and 6 — more than 12 million children — exceed the agency's health-protective limit, the toxicological reference value, or TRV. Grains (including rice) and baked goods are children's top exposure source (Schaefer 2023, Hoffman 2024, Unleaded Kids 2024). Rice with elevated cadmium contributes to the ongoing risk children face from pervasive cadmium residues in food.

Although no regulations currently require testing, manufacturers have the ability to routinely screen their products for heavy metals and remove lots with unusually high levels, helping to protect consumers from unnecessary exposure.

Brown versus white rice: A tradeoff between nutrition and arsenic?

Often, the choice between brown and white rice is framed as one between nutrition and arsenic exposure:

- Brown rice retains its outer bran and germ layers, which are rich in vitamins, essential minerals, and fiber (giving it a lower glycemic index than white rice)—but unfortunately, arsenic tends to concentrate in those same layers.
- White rice, in contrast, has those layers removed during processing, lowering its nutrient, fiber, and arsenic content. In the U.S., it's often enriched with iron and B vitamins to replace some of what is lost.
- Despite the nutritional benefits of brown rice, its **arsenic levels are high enough** that baby food manufacturers **stopped offering it as a single-ingredient infant cereal.**

Fortunately, brown rice isn't the only choice for nutrition. **Other whole grains — such as quinoa, bulgur, barley, and more — can provide even greater nutritional value** without the high arsenic levels. These grains are nutritious options for families (CR 2012, 2014; UPMC 2023; WHC 2025; Diabetes Canada 2025).

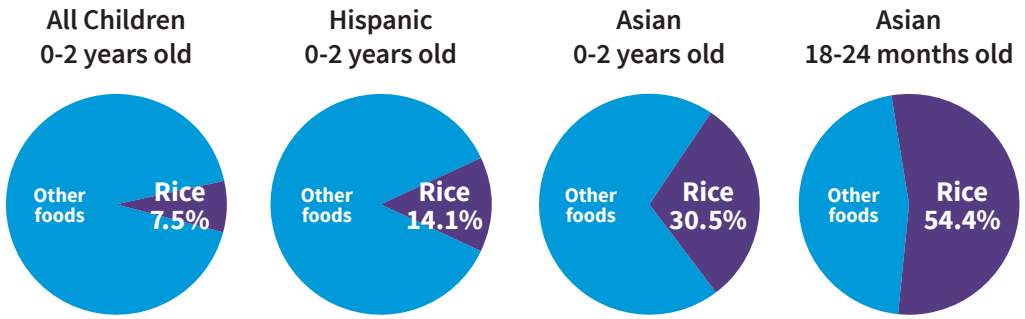
#6 - Change is vital for Asian, Latino, and Hispanic families, who eat rice more often than other families

Rice is the most widely eaten solid food in the world and a dietary staple for over a billion children (FAO 2024, USDA 2025a). It's also a leading source of arsenic in the diet.

For babies and toddlers under two, rice-based foods contribute more arsenic exposure than any other solid food. Children in Asian, Latino, and Hispanic families who rely on rice as a staple face even greater exposure. Rice contributes a significantly larger share of their daily dietary arsenic intake, up to seven times more than for other children (Abt 2025).

These high exposure levels make it critical for parents, rice companies, and policymakers to reduce arsenic in rice products and offer safer options for children.

Figure 6. Rice Is a Major Source of Arsenic in Children's Diets – Especially for Hispanic and Asian Children



Note: Chart reflects dietary inorganic arsenic exposure. Rice intake shown corresponds to rice and foods with rice as dominant component (e.g., rice and beans). It excludes infant rice cereal and mixed foods that contain rice as a non-dominant component. Source: Abt Associates dietary arsenic exposure analysis (Abt 2025).

The role of rice in family diets: Insights from a community survey.

Alongside our study, 35 families from our partner organizations (see Acknowledgments) or their broader communities participated in a non-scientific survey to share how rice factors into their daily lives. The results highlight the importance of rice as a dietary staple for many families.

Among respondents:

- Three-fourths identify as Asian American, Hispanic, or Latino.
- One in six eat rice twice a day or more.
- One in eight introduce rice to infants at 6 months or younger, and one-third serve it to babies by their first birthday.
- For one-third of families, rice is either an important, frequent main dish or the single most important food in their diet.

When asked about rice's role in their meals, families shared:

- *"…When we are busy or don't have much to make at home, the go-to meal is rice and beans because those are items our household will always have and can afford."*
- *"My family has to have rice as the main dish with most meals. Even for breakfast, they sometimes eat porridge..."*
- *"We buy several 25+ lb bulk bags from Costco or Grocery Outlet—and they don't last long!"*

This survey underscores just how deeply rice is woven into the diets of many American families and reinforces the need to reduce its arsenic and cadmium.

#7 – No evidence of progress to reduce arsenic levels in rice

Rice testing over the past 13 years, including analyses of rice from decades prior to that, does not indicate a decline in arsenic levels over time. The five studies highlighted below show average inorganic arsenic levels in white rice consistently hovering just above 90 ppb. These persistently high levels are concerning, especially given the industry's and the FDA's long-standing awareness of the issue.

Figure 7: Inorganic arsenic in white rice sold in the U.S., average levels

Date	Arsenic (inorganic, ppb)	Source	Number of samples tested	Reference
Decades prior to 2012	Comparable to 2012 levels	Senior FDA Adviser, on FDA analysis of rice sampes that were decades old: "they were identical to what we were seeing in modern samples."	unknown	Weiss 2013
2012-2013	91	FDA's 2016 comprehensive arsenic in rice exposure and risk analysis. Represents market-wide average for white rice.	429	FDA 2016
2009-2016	93	U.S. testing of white rice (combined results from multiple studies)	not provided	Scott 2025
2013-2023	90	Lundberg Family Farms: Arsenic testing results for Lundberg rice (includes all rice varieties grown). No trend seen over 11 years.	525	Lundberg 2025
2024-2025	92	HBBF's study of arsenic in rice and other grains. Test results for white rice (excludes parboiled and instant samples).	40	Current study

This cooking method can remove up to 60% of arsenic from rice at home

Research has shown that cooking rice in excess water — similar to the pasta method — can remove up to 60% of its inorganic arsenic content. This method is effective across all rice types, including both white and brown. Typically, six to ten cups of water are used for each cup of rice, with the excess water discarded after cooking (FDA 2022). Pre-soaking the rice for as little as 30 minutes or even overnight can further reduce arsenic levels (e.g., Mosley 2017, Gupta 2023). In contrast, rinsing rice is not consistently effective at lowering arsenic content.

However, these cooking methods can lead to the loss of important nutrients. Soaking, rinsing, and cooking in excess water all contribute to washing away the vitamins and iron that are added back to white rice after milling removes the nutrient-rich bran and germ. Levels of folate, iron, niacin, and thiamine can drop by 50% to 70% (FDA 2022), and potassium levels are also reduced (Meharg 2025). Brown rice, while naturally nutrient-dense to begin with, still loses some of its potassium and B vitamins during these cooking processes — though iron tends to remain intact (Gray 2016; Meharg 2025).

To help ensure children maintain a nutrient-rich diet, parents using the pasta cooking method can pair rice-based meals with nutrient-dense foods such as beans, lentils, leafy greens, fruit, and eggs. Incorporating a variety of other whole grains — many of which were tested in this study — can further boost nutritional intake. Lower-nutrient rice can still be part of a healthy, balanced diet when combined with a diverse mix of whole grains and other nutritious foods. The USDA recommends that at least half of the grains consumed each day be whole grains, rather than refined grains like white rice (USDA 2025b).

The heavy metals in rice can pose health risks, including diminished intelligence

After its first significant rice testing initiative in 2013, FDA's Commissioner noted that "All of the data suggest [arsenic] levels that are not high enough to give us cause for concern for immediate or near-term effects," giving parents some level of reassurance (Weiss 2013). HBBF's tests also find levels of heavy metals in rice — arsenic, cadmium, lead, and mercury — that are far lower than those that can cause acute poisoning, such as the lead-contaminated applesauce that sickened at least 22 children in 2023. Instead, the concern with heavy metals in rice lies in chronic, low-level exposures that accumulate over time — especially during critical developmental periods like pregnancy, infancy, and early childhood.

No amount of these mixtures of heavy metals is known to be safe. Collectively, they are linked to cancer and neurodevelopmental harm, including IQ loss and cognitive and behavioral issues. While the risk to any one child is typically small, repeated low-level exposures can have lasting effects and become especially significant when considered across the entire population. This is why the FDA has already acted to limit arsenic in infant rice cereal. Now, it should extend those protections to rice as a whole. In the meantime, parents can take steps to reduce their children's exposure. Just as small risks accumulate over time, so do small actions to minimize them, helping to protect children's health for the long term.

Rice is just one of many foods that contains heavy metals. In 2022, HBBF testing found these contaminants in 94% of both commercial and homemade baby foods. But rice stands out — not only because it has high arsenic levels, but also because it is widely consumed, leading to significant cumulative exposure.

All four metals found in rice can be harmful to a child's developing brain and nervous system. However, since arsenic and cadmium are the most prevalent, we focus on their risks below.

Arsenic

Arsenic is a well-known toxic substance linked to lung, bladder, and skin cancer, as well as heart disease and diabetes. But it also poses a risk to the developing brain. In its recent assessment of arsenic's health effects, the Environmental Protection Agency (EPA) reviewed 63 studies on arsenic's impact on IQ and neurodevelopment (EPA 2025). The agency found that early-life exposures are associated with reduced IQ and a range of cognitive and behavioral problems for children and teenagers. Impacts occur even at typical background exposures in the U.S. (Signes-Pastor 2022).

An economic analysis commissioned by HBBF examined the impact of arsenic in rice-based foods on childhood IQ loss. Researchers at Abt Global, a leading toxicology and economic research firm, estimated that arsenic in these foods is responsible for up to 9.2 million lost IQ points among U.S. children ages 0-6. This widespread harm translates to an annual economic loss of $12-18 billion in diminished future earnings (Abt 2017).

Widespread exposure to arsenic in rice — like children's exposure to lead — shifts the population-wide IQ curve downward, pushing more children into special education and reducing the number of highly gifted children. For affected children, the harm appears to be permanent (Wasserman 2007 and 2016, Hamadani 2011).

Cadmium

Cadmium is a toxic heavy metal linked to cancer, neurodevelopmental harm, and damage to the kidneys, bones, and heart. It is widely used in industry, is naturally present in water and soil, and contaminates food and the environment. Though less well-known than arsenic or lead, cadmium deserves attention from parents, companies, and regulators. Research shows it presents risks to health even at low levels of exposure.

A 2019 review found that prenatal cadmium exposure can impair children's language skills, cognitive development, and overall performance ability (Liu 2019). Among the supporting evidence is a study led by Harvard researchers reporting that children with higher cadmium exposure—at levels previously considered safe—were three times more likely to have learning disabilities or require special education (Ciesielski 2012).

Many children in the U.S. are exposed to excessive levels of cadmium in food. FDA scientists estimate that more than half of children ages 1 to 6—over 12 million kids—consume cadmium at levels exceeding the agency's health-protective limit, the Toxicological Reference Value or TRV. Grains, including rice and baked goods, are the top source (Schaefer 2023, Hoffman 2024).

FDA's current limit is meant to prevent cadmium from accumulating in the body over time, reducing the risk of kidney and bone damage by middle age (Schaefer 2023). It is not an enforceable limit in rice, but it could be used by the agency to determine if a product with elevated cadmium is adulterated and unfit for sale. The agency has yet to set a standard to protect the developing brain, despite growing evidence of the risks.

Figure 8: Arsenic vs Cadmium - Relative toxicity: Which requires a stricter limit? Health agency determinations on levels safe enough for the public, in water, food, and consumer products

Limit applies to…	Legal or Recommended Limit (health-based; most also include feasibility considerations)	Inorganic arsenic limit "with health impact(s) highlighted by the agency"	Cadmium limit "with health impact(s) highlighted by the agency"	Units*	Reference
Drinking water	Legal limit in drinking water (U.S. Environmental Protection Agency)	**10** Cancer, heart disease	**5** Kidney damage	ug/L (parts per billion)	EPA 2025b
All products sold in California	Posted warning on products is required above this exposure limit (California Proposition 65)	**10** Cancer	**4.1** Reproductive toxicity	ug/day	OEHHA 2023
Food and other exposure sources	Health-based limit used to set federal safety standards (Reference dose - U.S. Environmental Protection Agency)	**0.06** Diabetes and heart disease	**1** Kidney damage	ug/kg-day	EPA 2025, 1989
Grains	Health-based limits in grain. Arsenic: FDA limit for inorganic arsenic in infant rice cereal. Cadmium: International "Codex" limit in quinoa.	**100** Neurodevelopmental harm	**150** Kidney damage	ug/L (parts per billion)	FDA 2020, Codex 2024, WHO 2021

*Note: ug/L = micrograms of contaminant per liter of water; ug/day = micrograms of contaminant per day(a person's daily exposure amount); ug/kg-day = micrograms of daily exposure per kilogram of body weight.

What is the risk trade-off between arsenic and cadmium? Swapping alternative grains for rice almost always reduces arsenic exposure but slightly increases cadmium intake. Is this trade-off worth it?

On average, rice contains 28 times more arsenic than alternative grains, while alternative grains contain 1.5 times more cadmium than rice, based on our tests of 211 samples. For arsenic and cadmium, FDA has yet to establish comparable health-based limits to protect pregnant women and young children, making direct risk comparisons challenging. However, as shown in Figure 8, legal or recommended limits from various agencies highlight two key points: both contaminants are linked to significant health concerns, and expert opinions vary on relative thresholds that are safe enough for the public.

Given the potential health risks of arsenic and cadmium, even at relatively low levels, it makes sense to diversify grains in the diet rather than rely on rice as a daily staple, to help minimize cumulative exposure. The contaminant profile of rice also underscores the need for FDA action—to assess the combined risks of rice contaminants so that FDA's mitigation efforts and consumer guidance reflect a more comprehensive understanding of risk, rather than focusing on arsenic alone.

Try these rice substitutes: Recipes and cooking tips

Homemade baby cereal

Popular grains include oatmeal, quinoa, barley, buckwheat, and farro. Grind the whole grain in a coffee grinder and cook with some added liquid on the stovetop for about five minutes.

Recipes to try:

- Homemade baby cereal

Amaranth (gluten-free)

Amaranth has a mildly peppery flavor and a crunchy texture that's a lot like quinoa. Amaranth seeds are boiled like rice or quinoa for 20 to 30 minutes. The tiny granules stick together to form a porridge-like texture.

Compared to rice: 77% less heavy metals, 6 times more expensive per serving.

Recipes to try:

- Mexican style amaranth bowl
- Mexican ranchero amaranth stew
- Tabouli recipe with amaranth grain

Barley

Barley is a hearty, chewy grain commonly used in soups, stews, salads, and grain bowls. Cooks on the stovetop in about 20-50 minutes depending on whether you opt for the quicker pearl variety, or hulled.

Compared to rice: 82% less heavy metals, 3 times more expensive per serving.

Recipes to try:

- Vegetable and barley soup

Buckwheat (gluten-free)

Buckwheat's small, nugget-type granules can be used in the same way as rice. You can also find buckwheat as flour, noodles or even flakes. It is a convenient substitute for wheat flour. Cooks on the stovetop like rice, requiring 18 to 20 minutes of cooking time.

Compared to rice: 65% less heavy metals, 5 times more expensive per serving.

Recipes to try:

- Buckwheat stir fry
- Savory buckwheat and vegetables
- Chunky chocolate buckwheat granola

Bulgur

This nutty, chewy and earthy grain is made of cracked, debranned, partially cooked (parboiled) wheat. It's usually ready within 12 to 25 minutes on the stovetop, depending on the coarseness. Coarse bulgur wheat can typically be used in any recipe that calls for brown rice — they're similar in taste and texture.

Compared to rice: 73% less heavy metals, 4 times more expensive per serving.

Recipes to try:

- Bulgur salad
- Bulgur vegetarian taco meat
- Vegetarian (or not) chili with bulgur

Cauliflower rice (gluten-free)

Cauliflower rice is finely chopped cauliflower, processed in a food processor to resemble the size and appearance of rice grains. You can make it or buy it, and it works for almost any meal that calls for brown or white rice. It cooks on the stovetop in about 5-8 minutes. Cauliflower rice is a nutritious alternative to rice.

Recipes to try:

- Cauliflower rice
- Crispy peanut tofu and cauliflower rice

Couscous

Couscous is a type of pasta made from semolina flour mixed with water, forming small pieces that resemble grains. Couscous is available in many shapes and sizes, ranging from tiny grains to larger pearls. Couscous is typically ready in 5 to 10 minutes on the stovetop and can also be prepared in a rice cooker.

Compared to rice: 70% less heavy metals, 7 times more expensive per serving.

Recipes to try:

- Mediterranean couscous salad with roasted tomatoes and chickpeas.
- Grain salad - Sub couscous in place of quinoa
- Lemon couscous pilaf.
- Couscous bowl. Prepare couscous according to package directions. Then, top it with roasted veggies like cauliflower, Brussels sprouts, or butternut squash, drizzles of tahini sauce, and your favorite protein.

Farro

Farro has a nutty flavor and satisfying chewy texture. It is cooked in boiling water like pasta, until tender. It can also be prepared in a rice cooker. Cooking times vary by farro type (i.e., pearled, semi-pearled, and whole), ranging from 15 minutes for pearled to 40 minutes for whole.

Compared to rice: 68% less heavy metals, 5 times more expensive per serving.

Recipes to try:

- Cilantro lime farro (like Chitpotle's cilantro lime rice)
- Farro fried rice

Millet (gluten-free)

Millet has a mild and slightly nutty flavor and works well in sweet and savory dishes. It can be prepared like rice and cooks in less than 30 minutes. Millet can be made fluffy like many rice varieties or creamy like porridge depending on the amount of water used.

Compared to rice: 61% less heavy metals, 4 times more expensive per serving.

Recipes to try:

- Simple millet congee
- Millet congee with chicken and shiitake
- Millet cakes with carrots and spinach
- Creamy vanilla millet porridge

Oatmeal (gluten-free)

Oats are a cereal grain, from the edible seed of oat grass. Oats come in many textures based on how they are processed, e.g., steel-cut or Irish, Scottish, rolled or old-fashioned, quick or instant. Cooking times vary based on the oat type, ranging from 20 to 30 minutes or more for steel-cut or Irish oats to just a few minutes for instant oats.

HBBF's tests of oatmeal find heavy metals levels that are significantly lower than those in rice (HBBF 2019, 2022)

Recipes to try:

- Ecuadorian oatmeal drink
- Oatmeal
- Horchata overnight oats
- Chewy peanut butter granola bars

Polenta (gluten-free)

Polenta is made from stone-ground dried corn kernels. It has a reputation for being difficult to prepare, with a long prep time and a potential for lumps to form. However, it's easy to make creamy "instant" polenta in about 20 minutes using the recipe below. It's an easy alternative to rice, potatoes, pasta, and bread.

Although HBBF did not test polenta, FDA's tests of corn show low levels of heavy metals relative to rice (HBBF 2022).

Recipes to try:

- Creamy polenta
- Miso polenta with spring vegetables

Quinoa (gluten-free)

Quinoa has a mild flavor similar to brown rice. It absorbs flavors while cooking, making it easy to customize to your tastes. It can be prepared on the stovetop in about 15 minutes.

Compared to rice: 71% less heavy metals, 7 times more expensive per serving.

Recipes to try:

- Thai quinoa salad
- Fried rice with quinoa
- Quinoa with tomatillo and cilantro sauce

Spaghetti squash (gluten-free)

Spaghetti squash can be used as a substitute for rice in many dishes. The cooked squash naturally forms spaghetti-like noodles, absorbs flavors well, and is low in carbohydrates and calories. Spaghetti squash is a nutritious alternative to rice.

Recipes to try:

- 15 minute Instapot spaghetti squash
- Singapore noodles with spaghetti squash
- Spaghetti Squash Pad Thai

Spelt

Spelt is a protein-rich, nutrient-dense whole grain with a nutty and sweet flavor. It is cooked on the stovetop using the pasta method, with a cooking time of 30 to 60 minutes. Cooked spelt can be substituted for rice or pasta in recipes.

Compared to rice: 49% less heavy metals, 3 times more expensive per serving.

Recipes to try:

- Spicy chicken and spelt salad
- Toasted spelt soup with white beans and escarole

Conclusion

The persistence of arsenic and cadmium in rice, despite decades of awareness, underscores the need for stronger federal and state action — and continued action by parents to reduce children's exposures. While progress has been made in reducing arsenic levels in infant rice cereal, our findings highlight that contamination remains widespread in rice itself — posing ongoing risks to babies, pregnant women, and families who consume rice regularly. Until the FDA and states set protective limits and mandate transparency in testing, the burden falls on parents and consumers to make safer choices. Simple steps, such as cooking rice like pasta in extra water, incorporating alternative grains, and selecting lower-contamination rice varieties can significantly reduce heavy metal exposure and protect long-term health.

Federal action is both necessary and achievable. Setting limits on arsenic and cadmium in rice, requiring public reporting of heavy metal levels, and allowing labeling that identifies safer rice options would empower families and drive industry-wide improvements. As science continues to reveal the lasting effects of chronic heavy metal exposure, the FDA can act to make a meaningful difference for families. In the meantime, public awareness and consumer advocacy will remain crucial forces in the push for safer food.

Ten thousand babies in the U.S. begin eating solid food every day, and rice is a popular early food. Acting now will help protect this generation and the next from unnecessary and preventable harm.

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APPENDIX A

Laboratory test results of 211 samples of rice and other grains

Background

Results for analysis of four contaminants in a variety of rice and other grains are listed below. Testing was commissioned by HBBF and performed by Brooks Applied Labs in Seattle, Washington. Grains were tested in 2024 and 2025 for total recoverable arsenic, speciated arsenic (inorganic arsenic is shown below), and total recoverable cadmium, lead, and mercury. Appendix B provides a summary of analytical methods.

"ND" with the qualifier "<" indicates that the analyte was not detected (below the method detection limit), while the symbol "*" indicates test results that are estimated, that fall between the limit of detection and the limit of quantification. The symbol "-" indicates that the analysis was not performed.

About estimated values: The table below shows results for all target analytes detected by the lab's instruments. Estimated values shown with the qualifier "*" have greater uncertainty than other results. The starred (*) values are the lab's best estimate of concentration, but the actual amounts may be higher or lower than these best estimates. These estimated test results are near the test's detection limit. They are higher than the detection limit but lower than the test's quantification limit. In contrast, results above the quantification limit don't carry the "*" qualifier - they have lower uncertainty and are not considered to be estimates. The lab's detailed reports that accompany this study give detection and quantification limits for each individual test result shown below.

HBBF Sample Number	Brand	Product	Arsenic (ug/kg)	Cadmium (ug/kg)	Lead (ug/kg)	Mercury (ug/kg)	Inorganic Arsenic (ug/kg)	Store	City, State
Arborio Rice									
HBR-003	Signature Select	Arborio Rice	148	138	ND (<1.0)	4.4*	99.7	Safeway	Kensington MD
HBR-079	Kroger	Arborio Rice	77.3	13.6	ND (<1.0)	ND (<3.6)	72.8	Food 4 Less	Huntington Park CA
HBR-173	Riso Scotti	Riso Italiano per Risotto Arborio	182	46	ND (<1.0)	5.2	108	Amazon online	---
HBR-183	Seggiano	Organic Arborio Risotto Rice	213	27.7	ND (<1.0)	3.7	156	Whole Foods Market	Rockville MD
HBR-188	Riso di Molinella	Superfino Arborio Rice	140	5.1	1*	3	98.7	Amazon online	---
HBR-189	Riso Scotti	Riso Italiano per Risotto Arborio	166	61.6	1.1*	5.4	101	Amazon online	---
HBR-193	365 Whole Foods Market	Arborio White Rice	204	12.1	ND (<1.0)	4.2	103	Amazon online - Whole Foods	---
HBR-194	Sanniti	Arborio Rice	150	19.9	ND (<1.0)	3.7	73.9	Amazon online	---
HBR-196	4 Sisters	Authentic Arborio White Rice	158	9.4	ND (<0.8)	4.3	87.9	Amazon online	---
HBR-197	Riso Di Molinella	Superfino Arborio Rice	116	9.4	ND (<1.0)	3.1	78.7	Amazon online	---

Note: ug/kg (parts per billion) = micrograms of contaminant per kilogram of dry grain (except in samples with added water, noted as "ready-to-heat", which are given on a wet weight basis)

HBBF Sample Number	Brand	Product	Arsenic (ug/kg)	Cadmium (ug/kg)	Lead (ug/kg)	Mercury (ug/kg)	Inorganic Arsenic (ug/kg)	Store	City, State
Basmati Rice									
HBR-008	Lundberg Family Farms	White Rice Basmati Regenerative Organic Certified	64.6	10.9	ND (<1.0)	ND (<3.6)	41.8	Safeway	Kensington MD
HBR-021	Trader Joe's	Organic Basmati Rice from India	52.7	57.6	1.2*	ND (<3.5)	29.6	Trader Joe's	Denver CO
HBR-026	Trader Joe's	Organic Basmati Rice from India	44.5	40	1.8*	ND (<3.6)	35.1	Trader Joe's	Arlington VA
HBR-052	Bombay Market	Naturally Aromatic Basmati Rice	72.3	41.8	3.1	ND (<3.5)	56	Extra JUMBO by Associated	Washington Heights, Manhattan NY
HBR-055	La Constanzera	Basmati Rice, Arroz para Diabetico	72.4	10.2	2.5*	ND (<3.5)	65.6	Fine Fare Supermarkets	Washington Heights, Manhattan NY
HBR-061	Krasdale	Basmati Rice	71.7	25.8	7.3	ND (<3.5)	62.7	Hong Kong Supermarket	Chinatown, Manhattan NY
HBR-086	Mahatma	Basmati Naturally Fragrant Rice	65.8	24.8	ND (<1.0)	ND (<3.6)	57.5	CARRS Safeway	Anchorage AK
HBR-087	Royal	Authentic Basmati Rice	57.9	10.8	ND (<0.9)	ND (<3.2)	48.2	CARRS Safeway	Anchorage AK
HBR-115	Minute	Basmati Rice (ready-to-heat)	24.6	8.4	ND (<1.0)	ND (<3.4)	16.2	Rouses Markets	Waiting for this info LA
HBR-118	Kroger	Basmati Rice	103	108	2.4*	ND (<3.3)	81.1	Kroger	Maumelle AR
HBR-127	Ti-Machan'n	Indian Basmati - Basmati Riz Chaude Rice Parboiled	57.2	15.1	2.8*	ND (<3.6)	38.5	A&K Supermarket	Miami FL
HBR-144	Lundberg Family Farms	Sustainable California White Basmati Gourmet Rice	79.2	7.8	ND (<1.0)	ND (<3.6)	38.3	Whole Foods Market	San Francisco CA
HBR-147	Royal	Basmati Rice	65.5	9.6	2*	ND (<3.6)	54.1	Smart & Final	San Francisco CA
HBR-192	Iberia	Basmati 100% Aged Original	134	24.6	1.2*	2.4	96.2	Amazon online	---
HBR-198	Royal	Organic Basmati Rice	41.1	43.1	1.1*	1*	18.2	Amazon online	---
HBR-199	Khazana	Premium Basmati Rice	85.4	24.3	1.7*	1.1*	70.2	Amazon online	---
HBR-202	Pride of India	Indian White Basmati Rice	85.4	19	2.7*	1.6*	61.6	Amazon online	---
HBR-203	Signature Select	Basmati Rice	199	25.1	1.7*	5.2	119	Safeway	Kensington MD
HBR-009	RiceSelect	Brown Texmati Signature Variety American Style Basmati Rice	522	6.8	1.1*	ND (<3.3)	123	Safeway	Kensington MD
Brown rice									
HBR-010	Mahatma	Brown Whole Grain Rice	201	17.6	ND (<1.0)	ND (<3.4)	149	Safeway	Kensington MD
HBR-019	Sarita	Organic Long Grain Brown Rice	174	18.6	ND (<1.0)	ND (<3.4)	96.5	Grocery Outlet	San Diego CA
HBR-033	4 Sisters	Extra Long Grain Organic Brown Rice	203	31	ND (<1.0)	ND (<3.6)	106	King Soopers	Denver CO
HBR-049	Nishiki	Premium Brown Rice Medium Grain Rice Special Selected	217	4.4	ND (<1.0)	ND (<3.5)	141	Food Express Supermarket	Woodside, Queens NY
HBR-076	Mahatma	Brown Whole Grain Rice	192	25.9	ND (<1.0)	4.2*	155	Superior Grocers	South Central, Los Angeles CA
HBR-082	First Street	Long Grain Brown Rice	317	11.6	3*	ND (<3.6)	201	Smart & Final	West Adams, Los Angeles CA
HBR-107	Ben's Original	Whole Grain Brown Rice (parboiled)	253	14.8	1.4*	5*	149	Food Lion	Chapin SC
HBR-111	Cajun Country	100% Louisiana Long Grain Brown Rice	157	27.6	ND (<1.0)	ND (<3.5)	118	Rouses Markets	Waiting for this info LA

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HBR-116	Rouses Markets	Brown Rice Long Grain	293	7.5	1.3*	ND (<3.6)	176	Rouses Markets	Waiting for this info LA
HBR-117	Kroger	Long Grain Brown Rice	219	19.3	ND (<1.0)	ND (<3.6)	140	Kroger	Maumelle AR
HBR-124	Hannaford	Long Grain Brown Rice	188	12.7	ND (<1.0)	3.9*	141	Hannaford	Topsham ME
HBR-180	Lundberg Family Farms	Brown Rice Long Grain Regenerative Organic Certified	76.7	12.8	ND (<1.0)	4.6	63.4	Whole Foods Market	Rockville MD
HBR-181	Lundberg Family Farms	Brown Rice Short Grain Regenerative Organic Certified	92.1	2.9	ND (<1.0)	0.9*	75.7	Whole Foods Market	Rockville MD
HBR-195	4 Sisters	Extra Long Grain Organic Brown Rice	305	10.9	ND (<1.0)	3.6	147	Amazon online	---
HBR-204	Mahatma	Brown Whole Grain Rice	127	21.4	3.3	1.5*	74.7	Safeway	Kensington MD
Calrose Rice									
HBR-013	Botan	Calrose Rice	136	4.3	ND (<0.9)	ND (<3.2)	79.6	Safeway	Kensington MD
HBR-141	Botan	Calrose Rice	86.6	5.1	ND (<0.9)	ND (<3.4)	49.5	H Mart	San Francisco CA
HBR-171	Soeos	Sushi Rice Calrose Medium Grain	65.5	4.2	ND (<0.9)	0.4*	39.9	Amazon online	---
HBR-178	365 Whole Foods Market	Enriched Calrose Rice Medium Grain	95.7	2.7	ND (<1.0)	0.5*	67.4	Amazon online	---
HBR-200	Sadaf	Calrose Rice	80.3	3.9	ND (<1.0)	0.6*	52.5	Amazon online	---
Carolina Gold Rice									
HBR-176	Carolina Plantation	Carolina Gold Rice	162	12.7	1.5*	2.4	83.4	Amazon online	---
HBR-179	Marsh Hen Mill	Carolina Gold Rice	301	38.5	ND (<0.9)	2	110	Amazon online	---
Charleston Gold Rice									
HBR-175	Andy's	Charleston Gold Rice	276	105	2.8*	5.1	75.5	Amazon online	---
Glutinous Rice									
HBR-050	TKS	Thai White Glutinous Rice - Sweet Rice	117	20.9	ND (<1.0)	ND (<3.5)	75.8	Phil-Am Food Mart	Woodside, Queens NY
HBR-057	Lam Sheng Kee	Glutinous Rice	101	ND (<1.3)	ND (<1.0)	ND (<3.5)	69.8	Hong Kong Supermarket	Chinatown Manhattan NY
HBR-139	Hakubai	Premium Sweet Rice	142	5.5	ND (<1.0)	ND (<3.4)	81.2	H Mart	San Francisco CA
HBR-140	Koda Farms	California Grown Sho-Chiku-Bai Superior Short Grain Sweet Rice	77	5.2	ND (<0.9)	ND (<3.3)	68.7	Boss Supermarket	San Francisco CA
HBR-146	Dragonfly	Special Sweet Rice - Thai Glutinous Rice	85.2	18.3	ND (<1.0)	ND (<3.6)	59.3	Superb Garden Grocery	San Francisco CA
Japonica Rice									
HBR-137	Nishiki	Medium Grain Rice Specially Selected	91.7	2.3*	ND (<0.9)	ND (<3.2)	54.1	Nijiya Market #62	San Francisco CA
HBR-150	Tamanishiki	Super Premium Short Grain Rice	132	14.1	ND (<1.0)	ND (<3.5)	100	New May Wah Super	San Francisco CA
Jasmine Rice									
HBR-001	Lundberg Family Farms	Organic California White Jasmine Gourmet Rice	79.8	7.4	ND (<1.0)	4*	25.4	Safeway	Kensington MD
HBR-027	Trader Joe's	Organic Jasmine Rice from Thailand	129	7.7	ND (<1.0)	4.2*	93.3	Trader Joe's	Arlington VA
HBR-042	Lundberg Family Farms	White Rice Jasmine Regenerative Organic Certified	30	7	ND (<1.0)	ND (<3.5)	24	Safeway	Leadville CO

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HBR-051	Elephant Brand	Jasmine White Scented Rice	154	3.8	1.6*	ND (<3.5)	81.1	Phil-Am Food Mart	Woodside, Queens NY
HBR-063	Good & Gather	Jasmine Rice	93.6	3.1	ND (<1.0)	ND (<3.5)	91.5	Target	Houston TX
HBR-068	Sunlee	Jasmine Rice (Gao Ong Dia)	125	2.5*	ND (<1.0)	4.1*	85.2	H Mart	Houston TX
HBR-084	Kroger	Thai Jasmine Rice	122	4.8	ND (<1.0)	ND (<3.5)	101	Fred Meyer	Anchorage AK
HBR-095	Lundberg Family Farms	Sustainable California White Jasmine Gourmet Rice	70.8	23.1	ND (<0.9)	ND (<3.4)	53.9	Hilltop Red Apple Market	Seattle WA
HBR-106	Mahatma	Jasmine Thai Fragrant Long Grain Rice	99.7	6.9	ND (<1.0)	ND (<3.5)	84.8	Food Lion	Chapin SC
HBR-128	Ti-Machan'n	100% White Scented Rice Milagrosa - Extra Fancy Super Quality Jasmine Rice	95.2	2.8*	2.6*	ND (<3.6)	66.6	A&K Supermarket	Miami FL
HBR-131	Mama Lycha	Thai Jasmine Rice Long Grain Fragrant Rice	109	10.4	ND (<1.0)	ND (<3.5)	70.3	Not provided by shopper	Albuquerque NM
HBR-133	Kirkland Signature	Thai Hom Mali Jasmine Rice	114	5.4	ND (<1.0)	ND (<3.6)	86.6	Costco	San Francisco CA
HBR-135	Golden Phoenix	Pure Thai Premium Grade Hom Mali Jasmine Rice	119	6.1	ND (<1.0)	ND (<3.5)	66.7	SM Sunset Supermarket	San Francisco CA
HBR-136	Asian Taste	Jasmine Rice	121	5.1	ND (<1.0)	ND (<3.5)	70.8	99 Ranch Market	Foster City CA
HBR-138	Golden Phoenix	Pure Thai Premium Grade Hom Mali Jasmine Rice	121	5.3	ND (<0.9)	ND (<3.3)	68.3	Mi Duo Duo Market	San Francisco CA
HBR-142	H Mart	Thai Hom Mali Jasmine Rice	144	4.3	ND (<1.0)	ND (<3.5)	65.6	H Mart	San Francisco CA
HBR-145	Three Ladies	Jasmine Rice (Thai Hom Mali Rice) - Milagrosa Extra Super Quality	141	4.7	ND (<0.9)	ND (<3.3)	60.1	25th Irving Market	San Francisco CA
HBR-060	Dynasty	Jasmine Brown Rice	144	9.1	1.2*	3.8*	113	Hong Kong Supermarket	Chinatown, Manhattan NY
HBR-094	Lundberg Family Farms	Brown Jasmine Rice, Regenerative Organic Certified (ready-to-heat)	33.5	1.5*	ND (<0.9)	ND (<3.3)	15.2	Hilltop Red Apple Market	Seattle WA
HBR-151	Dragonfly	Thai Hom Mali Brown Rice	167	8.4	2*	5.4*	119	New Wing Hing Seafood Market	San Francisco CA
Kalijira Rice									
HBR-048	Putul	Aromatic Kalijira Rice	67.4	50	1.3*	ND (<3.6)	38	Mannan Halal Supermarket	Jackson Heights, Queens NY
Mixed Rice									
HBR-143	C.H. Trading Co	Mixed Rice	84.9	8.8	4.6	ND (<3.4)	59.1	Kukje Supermarket	Daly City CA
Morelos Rice									
HBR-072	Verde Valle	Morelos Enriched Rice	114	47	ND (<0.9)	7.2*	77.1	Mi Huerta Grocery	Berwyn IL
Mixed Grains (predominantly rice)									
HBR-148	Nishiki	Premium Multi Grain Seven Grains Mix	167	7.9	1.1*	ND (<3.5)	127	Nijiya Market #62	San Francisco CA
Unspecified Rice									
HBR-059	Dynasty Supermarket Corp	Rice (No product name listed on package)	100	10.8	ND (<1.0)	ND (<3.5)	83.6	Hong Kong Supermarket	Chinatown Manhattan NY

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Rice, Wild Blend									
HBR-043	Lundberg Family Farms	Sustainable Wild Blend Gourmet Rice	106	6	ND (<1.0)	ND (<3.6)	107	Safeway	Leadville CO
Sushi Rice									
HBR-098	Lundberg Family Farms	Organic California Sushi Gourmet Rice	107	2.6*	ND (<1.0)	ND (<3.5)	80.1	Hilltop Red Apple Market	Seattle WA
HBR-134	Kokuho Rose	California Supreme Rice - California's Original Sushi Rice	120	3.1	ND (<1.0)	ND (<3.6)	80.9	Costco	South San Francisco CA
HBR-172	RiceSelect	Sushi Premium Short Grain Rice	169	6.3	1.2*	1.2*	67.2	Amazon online	--
HBR-182	Lundberg Family Farms	Organic California Sushi Gourmet Rice	41.3	10.3	ND (<1.0)	0.9*	37.5	Whole Foods Market	Rockville MD
HBR-190	Pereg	Sushi Rice Sticky	81.7	4.9	2.2*	1*	54	Amazon online	--
HBR-201	365 Whole Foods Market	Sushi Rice Short Grain White	113	2.9	1*	0.4*	71.1	Amazon online - Whole Foods	--
Thai Long Grain Rice									
HBR-056	Arroz Rico	Arroz Rico Rice Long Grain	111	13.9	ND (<1.0)	ND (<3.6)	101	Williams Grocery Corp.	Washington Heights, Manhattan NY
White Rice									
HBR-016	Omega Rice	Long Grain Enriched Rice	171	30.6	1.1*	ND (<3.5)	81.3	Dollar Tree	San Diego CA
HBR-017	Clover Valley	Long Grain White Rice	128	66.8	ND (<1.0)	ND (<3.5)	72.3	Dollar General	Franklin NC
HBR-018	Mahatma	Extra Long Enriched Rice	113	19.2	ND (<1.0)	ND (<3.4)	68.3	Dollar General	Franklin NC
HBR-020	Roberts	A-1 Premium Long Grain Enriched Rice	219	30.5	ND (<1.0)	5.2*	75.6	Grocery Outlet	San Diego CA
HBR-038	Mahatma	Extra Long Enriched Rice	144	23.5	ND (<1.0)	4.3*	101	King Soopers	Cheyenne WY
HBR-040	Zatarain's	New Orleans Style Long Grain Rice Enriched Parboiled	218	14.4	7.1	ND (<3.4)	129	King Soopers	Cheyenne WY
HBR-047	Canilla	Extra Long Grain Enriched Rice	281	9.7	2*	ND (<3.5)	130	Mi Tierra Supermarket	Jackson Heights, Queens NY
HBR-053	Riceland	White Enriched Long Grain Rice	283	27.5	ND (<1.0)	6.5*	97.1	The Food Emporium	Washington Heights, Manhattan NY
HBR-054	Carolina	Enriched White Rice Extra Long Grain	138	20.7	ND (<1.0)	ND (<3.6)	91.9	The Food Emporium	Washington Heights, Manhattan NY
HBR-058	Select Kagayaki	California Premium Short Grain	101	10.6	ND (<1.0)	ND (<3.5)	79.2	Hong Kong Supermarket	Chinatown Manhattan NY
HBR-062	Supreme Rice	Enriched Rice	115	18.9	ND (<0.9)	ND (<3.4)	74.1	Fiesta Mart	Houston TX
HBR-064	Golden Canilla Dorado	Parboiled rice enriched long grain	174	18.7	1.3*	ND (<3.4)	112	Fiesta Mart	Houston TX
HBR-065	Clover Valley	Long Grain White Rice	131	17.2	ND (<1.0)	ND (<3.5)	84.4	Dollar General	Houston TX
HBR-066	Mahatma	Extra Long Enriched Rice	169	34.3	1*	3.7*	102	Dollar General	Houston TX
HBR-069	Adolphus	Enriched Long Grain Premium Select Rice	137	16.5	ND (<1.0)	ND (<3.6)	101	Fiesta Mart	Houston TX
HBR-070	Verde Valle	Enriched Rice Extra Long Grain	126	22.8	ND (<0.9)	ND (<3.2)	91.2	Fiesta Mart	Houston TX
HBR-071	El Mexicano	Arroz - Long Grain Enriched Rice	197	14.4	1.5*	ND (<3.3)	119	Supermercado Sanchez	Cicero IL
HBR-073	Goya	Enriched Medium Grain Rice	342	8.6	ND (<1.0)	8.9*	128	Cermak Fresh Market	Chicago iL

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HBR-074	La Preferida	Extra Long Grain, Extra Fancy Enriched Rice	153	14.9	ND (<1.0)	4*	92	Cermak Fresh Market	Chicago IL
HBR-075	Canilla	Extra Long Grain Enriched Rice	166	19.5	ND (<1.0)	ND (<3.6)	94	Supermercado Sanchez	Cicero IL
HBR-077	Faraon	Fancy Extra Long Grain Enriched Rice	253	14.1	ND (<1.0)	ND (<3.5)	108	Superior Grocers	South Central, Los Angeles CA
HBR-078	Mahatma	Extra Long Enriched Rice	150	14.3	1.1*	4*	91.3	Food 4 Less	Huntington Park CA
HBR-080	El Mexicano	Arroz - Long Grain Enriched Rice	164	15.4	ND (<0.9)	ND (<3.4)	98.2	Food 4 Less	Huntington Park CA
HBR-081	Blue Ribbon	Extra Long Grain Enriched Rice	138	45	ND (<1.0)	ND (<3.6)	87.8	Smart & Final	West Adams, Los Angeles CA
HBR-083	First Street	Extra Fancy Enriched Long Grain Rice	158	23.4	ND (<0.9)	ND (<3.4)	93.2	Smart & Final	West Adams, Los Angeles CA
HBR-089	Doguet's	Extra Fancy Enriched Long Grain Rice	264	17.2	2*	ND (<3.4)	113	H-E-B	Pearland TX
HBR-091	Canilla	Extra Long Grain Enriched Rice	208	35.1	ND (<1.0)	ND (<3.5)	109	Food Town	Houston TX
HBR-096	Food Club	Instant White Rice - Enriched Long Grain	111	14.5	ND (<1.0)	4.8*	44.6	Hilltop Red Apple Market	Seattle WA
HBR-104	Dixie Lily	Parboiled Yellow Rice with Saffron	122	34.3	29.4	3.5*	78.1	Food Lion	Chapin SC
HBR-110	Rouses Markets	Rice Long Grain Enriched	145	16.6	1.1*	ND (<3.6)	113	Rouses Markets	Waiting for this info LA
HBR-112	Falcon	Rice - Enriched Fancy Long Grain	143	15.2	1.1*	ND (<3.5)	104	Rouses Markets	--
HBR-113	Parish Rice	Parish Rice - Higher Protein	149	2.2*	ND (<1.0)	ND (<3.5)	95.6	Rouses Markets	Waiting for this info LA
HBR-122	Market Basket	Instant Rice - Enriched Pre-cooked Long Grain	118	18.8	ND (<1.0)	6.4*	54.7	Market Basket	Topsham ME
HBR-129	Sprouts	Organic Long Grain White Rice	292	5.1	ND (<1.0)	ND (<3.5)	76.3	Not provided by shopper	Albuquerque NM
HBR-130	El Mexicano	Arroz - Long Grain Enriched Rice	127	9	ND (<1.0)	ND (<3.6)	75.3	Not provided by shopper	Albuquerque NM
HBR-132	White Emerald	Enriched Extra Long Grain Rice	181	19.7	ND (<0.9)	ND (<3.2)	97.9	Costco	South San Francisco CA
HBR-149	Nijiya	Premium Organic Medium Grain Rice	50.7	2.5*	ND (<1.0)	ND (<3.6)	40.1	Nijiya Market #62	San Francisco CA
HBR-153	Mahatma	Extra Long Enriched Rice	143	22	ND (<0.9)	ND (<3.1)	87.6	Carniceria los Tapatios #2	Denver CO
HBR-154	El Mexicano	Arroz - Long Grain Enriched Rice	279	13.5	ND (<1.0)	ND (<3.5)	77.4	Carniceria los Tapatios #2	Denver CO
HBR-155	La Tona	Arroz Blanco - Long Grain Rice	255	6.1	ND (<1.0)	5.4*	116	Carniceria los Tapatios #2	Denver CO
HBR-157	organics	Organic White Rice Fully Cooked (ready-to-heat)	29.3	3.8	ND (<0.9)	ND (<3.1)	20.6	Safeway	Boulder CO
HBR-158	Mahatma	Seasoned Rice - Yellow Rice	158	11.6	1.2*	ND (<3.5)	77.7	Safeway	Boulder CO
HBR-160	Good & Gather	Instant White Rice Enriched Long Grain	84.4	13.4	ND (<0.9)	3.7*	37.3	Target	Boulder CO
HBR-162	Ben's Original	Ready Rice Long Grain White Original (ready-to-heat)	86.3	3.6	2.9	ND (<3.3)	65.6	King Soopers	Boulder CO
HBR-164	Kroger	Instant Enriched White Rice	109	16.4	ND (<0.9)	3.7*	35	King Soopers	Boulder CO
HBR-165	Vigo	Saffron Yellow Rice - Arroz Amarillo	116	50.5	4.9	ND (<3.5)	86.4	King Soopers	Boulder CO
HBR-166	Mahatma	Seasoned Rice - Yellow Rice	150	13.4	7.1	ND (<3.4)	90.9	King Soopers	Boulder CO
HBR-167	Vigo	Saffron Yellow Rice - Arroz Amarillo	129	50.7	6.5	1.2*	72	Harris Teeter	Bethesda MD

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HBR-169	Harris Teeter	Instant Boil-in-Bag Enriched White Rice	164	14.4	ND (<0.9)	5.6	78.9	Harris Teeter	Bethesda MD
HBR-170	Minute	White Rice Light & Fluffy (instant)	122	16.6	ND (<1.0)	3.7	51	Harris Teeter	Bethesda MD
HBR-174	Dixie Lily	Parboiled Yellow Rice with Saffron	141	21.7	36	3.6	85.4	Amazon online	--
HBR-184	Vigo	Saffron Yellow Rice - Arroz Amarillo	181	5.9	5.5	1.9*	106	Hen House	Leawood KS
HBR-185	Best Choice	Boil-in-Bag White Rice Enriched Precooked	99.3	14.3	ND (<1.0)	1.7*	68.6	Hen House	Leawood KS
Amaranth									
HG-030	SIMPLi	Amaranth Regenerative Organic Certified	3.5*	18.6	2.6*	0.6*	--	Whole Foods Market	Rockville MD
HG-043	Natural Grocers	Amaranth Grain Organic	3.2*	20	6.2	ND (<3.5)	--	Natural Grocers	Boulder CO
HG-057	Birch & Meadow	Amaranth Grains	3.1*	14.4	4.2	ND (<0.3)	--	Amazon online	--
Barley									
HG-002	Signature Select	Pearled Barley	2.3*	9.3	ND (<0.9)	ND (<3.2)	--	Safeway	Boulder CO
HG-010	Quaker	Pearled Barley - Quick	ND (<2.1)	15.9	ND (<0.9)	ND (<3.3)	--	King Soopers	Boulder CO
HG-042	Natural Grocers	Hulled Barley Organic	2.5*	11.2	ND (<0.9)	ND (<3.4)	--	Natural Grocers	Boulder CO
HG-048	Bob's Red Mill	Premium Quality Pearl Barley	ND (<2.0)	18.2	ND (<0.9)	ND (<3.2)	--	Hen House	Leawood KS
HG-052	Grain Place Foods	Organic Hulled Barley	2.7*	10.9	ND (<0.9)	0.9*	--	Amazon online	--
HG-053	Glicks Everyday	Pearl Barley - orge perlee	ND (<1.7)	19.5	ND (<1.0)	ND (<0.3)	--	Amazon online	--
HG-054	Yankeetraders	Hulled Barley	3.3*	23.9	ND (<1.0)	ND (<0.3)	--	Amazon online	--
HG-055	Food to Live	Hulled Barley	4.6*	18.4	ND (<1.0)	ND (<0.3)	--	Amazon online	--
HG-056	Yankeetraders	Pearled Barley	8.2	16.7	1*	ND (<0.3)	--	Amazon online	--
Buckwheat									
HG-012	Eden	Buckwheat Organic Whole Grain	ND (<2.1)	34.5	ND (<0.9)	ND (<3.3)	--	Whole Foods Market	Boulder CO
HG-022	Bob's Red Mill	Organic Whole Grain Buckwheat	ND (<1.5)	24.6	1.3*	0.4*	--	Harris Teeter	Bethesda MD
HG-028	Eden	Buckwheat Organic Whole Grain	2*	38	ND (<1.0)	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-041	Natural Grocers	Brown Buckwheat Organic	ND (<2.2)	28.8	11	ND (<3.5)	--	Natural Grocers	Boulder CO
HG-044	Natural Grocers	White Buckwheat Organic	ND (<2.3)	27.2	2.8*	ND (<3.5)	--	Natural Grocers	Boulder CO
HG-061	Eden	Buckwheat Organic Whole Grain	9.1	45.9	ND (<1.0)	0.4*	--	Amazon online	--
HG-062	Anthony's	Organic Buckwheat Groats, Hulled, Gluten Free	1.8*	31.3	ND (<1.0)	0.7*	--	Amazon online	--
Bulgur									
HG-006	Bob's Red Mill	Whole Grain Red Bulgur	6.1*	17.3	ND (<1.0)	ND (<3.6)	--	King Soopers	Boulder CO
HG-014	365 Whole Foods Market	Organic Whole Grain Bulgur Wheat	4.4*	36	2.3*	ND (<3.4)	--	Whole Foods Market	Boulder CO
HG-020	Bob's Red Mill	Whole Grain Red Bulgur	6.3	24.1	1.5*	0.4*	--	Harris Teeter	Bethesda MD
HG-034	365 Whole Foods Market	Organic Whole Grain Bulgur Wheat	ND (<1.6)	27.4	ND (<0.9)	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-045	Natural Grocers	Bulgur Wheat Organic	2.5*	5	ND (<1.0)	ND (<3.5)	--	Natural Grocers	Boulder CO

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HG-058	Duru	Coarse Bulgur #3	4.1*	8.5	ND (<0.9)	ND (<0.3)	--	Amazon online	--
HG-059	Iberia	Bulgur Wheat	6.3	44.9	ND (<1.0)	ND (<0.3)	--	Amazon online	--
HG-060	Sadaf	Bulghur #3 Coarse	7.9	29.6	2.2*	ND (<0.3)	--	Amazon online	--
Couscous									
HG-003	organics	Couscous	ND (<2.2)	9.4	ND (<1.0)	ND (<3.5)	--	Safeway	Boulder CO
HG-008	Kroger	Couscous Pearl	ND (<2.0)	26.3	1*	ND (<3.2)	--	King Soopers	Boulder CO
HG-011	Kroger	Couscous Original	7*	43.7	ND (<0.9)	ND (<3.1)	--	King Soopers	Boulder CO
HG-015	365 Whole Foods Market	Organic Couscous	2.5*	13.3	ND (<1.0)	ND (<3.6)	--	Whole Foods Market	Boulder CO
HG-024	RiceSelect	Pearl Couscous Toasted Israeli-Style Pasta	2.3*	24.7	1.2*	ND (<0.3)	--	Amazon online	--
HG-025	Bob's Red Mill	Golden Couscous	4.4*	43.2	ND (<1.0)	ND (<0.3)	--	Safeway	Kensington MD
HG-029	365 Whole Foods Market	Organic Couscous	3*	14.3	ND (<1.0)	0.5*	--	Whole Foods Market	Rockville MD
HG-031	Bob's Red Mill	Tri-color Pearl Couscous	7.8	40.9	5.5	1.1*	--	Whole Foods Market	Rockville MD
HG-032	RiceSelect	Couscous Moroccan-Style Pasta	4.2*	41.8	ND (<1.0)	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-051	RiceSelect	Pearl Couscous Toasted Israeli-Style Pasta	ND (<2.2)	22.8	1.1*	ND (<3.5)	--	Hen House	Leawood KS
Farro									
HG-007	Kroger	Ancient Grains Farro	8.5*	44.8	ND (<1.0)	ND (<3.5)	--	King Soopers	Boulder CO
HG-013	365 Whole Foods Market	Organic Italian Farro	2.5*	40.9	1.1*	ND (<3.4)	--	Whole Foods Market	Boulder CO
HG-017	Bob's Red Mill	Organic Farro	ND (<2.3)	37.8	ND (<1.0)	ND (<3.6)	--	Whole Foods Market	Boulder CO
HG-021	Nature's Earthly Choice	Organic Italian Pearled Farro	2.9*	8.8	2.7*	0.7*	--	Harris Teeter	Bethesda MD
HG-027	Bob's Red Mill	Organic Farro	3.4*	29.4	ND (<1.0)	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-035	365 Whole Foods Market	Organic Italian Farro	1.9*	12.7	ND (<0.9)	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-038	Bob's Red Mill	Organic Farro	ND (<2.1)	42.2	ND (<0.9)	ND (<3.3)	--	Natural Grocers	Boulder CO
HG-047	Bob's Red Mill	Organic Farro	ND (<2.2)	25.1	ND (<0.9)	ND (<3.4)	--	Hen House	Leawood KS
Millet									
HG-016	Eden	Millet Organic Whole Grain	7.9*	30.3	1.9*	ND (<3.6)	--	Whole Foods Market	Boulder CO
HG-023	Bob's Red Mill	Whole Grain Millet	12.2	47.1	ND (<0.8)	1.1*	--	Harris Teeter	Bethesda MD
HG-026	Eden	Millet Organic Whole Grain	8	34.2	1.2*	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-039	Eden	Millet Organic Whole Grain	8.2*	34.2	1.3*	ND (<3.4)	--	Natural Grocers	Boulder CO
HG-040	Natural Grocers	Millet Organic	7.1*	40.5	3	ND (<3.4)	--	Natural Grocers	Boulder CO
HG-066	Food to Live	Organic Millet Seeds	4.2*	9.4	ND (<0.9)	ND (<0.3)	--	Amazon online	--
HG-067	Now Real Food	Organic Millet Whole Grain Hulled	5.5	37.6	2.3*	ND (<0.3)	--	Amazon online	--
HG-068	Eden	Millet Organic Whole Grain	9.3	36.8	1.7*	ND (<0.3)	--	Amazon online - Whole Foods	--

Note: ug/kg (parts per billion) = micrograms of contaminant per kilogram of dry grain (except in samples with added water, noted as "ready-to-heat", which are given on a wet weight basis)

HBBF Sample Number	Brand	Product	Arsenic (ug/kg)	Cadmium (ug/kg)	Lead (ug/kg)	Mercury (ug/kg)	Inorganic Arsenic (ug/kg)	Store	City, State
Quinoa									
HG-001	organics	Quinoa	5.3*	17.5	2.8*	ND (<3.4)	--	Safeway	Boulder CO
HG-004	Good & Gather	Organic Quinoa	14.7	27.3	4.3	ND (<3.5)	--	Target	Boulder CO
HG-005	TruRoots	Organic Quinoa	7.8*	59.9	3.6	ND (<3.3)	--	King Soopers	Boulder CO
HG-009	Kroger	Quinoa	5.9*	18.2	ND (<0.9)	ND (<3.3)	--	King Soopers	Boulder CO
HG-018	Ancient Harvest	Gluten Free Traditional Quinoa	ND (<2.1)	15.9	2.4*	ND (<3.3)	--	Whole Foods Market	Boulder CO
HG-019	Nature's Earthly Choice	Organic Premium Quinoa	3.6*	20.6	5.1	0.5*	--	Harris Teeter	Bethesda MD
HG-033	SIMPLi	Red Quinoa	4.4*	18	1.5*	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-037	Ancient Harvest	Gluten Free Traditional Quinoa	ND (<1.6)	19.4	2*	ND (<0.3)	--	Whole Foods Market	Rockville MD
HG-050	RiceSelect	White Quinoa	ND (<2.3)	16.5	2.1*	ND (<3.6)	--	Hen House	Leawood KS
Spelt									
HG-046	Natural Grocers	Whole Spelt Organic	2.7*	39.2	1.6*	ND (<3.3)	--	Natural Grocers	Boulder CO
HG-063	Food to Live	Organic Spelt Berries	12.5	67.3	1.3*	ND (<0.3)	--	Amazon online	--
HG-064	Jovvily	Spelt Berries Whole Grain	14.9	50.5	1.2*	ND (<0.3)	--	Amazon online	--
HG-065	Yupik	Organic Spelt Kernels	2.5*	34.2	ND (<0.8)	ND (<0.3)	--	Amazon online	--

Note: ug/kg (parts per billion) = micrograms of contaminant per kilogram of dry grain (except in samples with added water, noted as "ready-to-heat", which are given on a wet weight basis)

APPENDIX B

Laboratory analysis: summary of methods

Background

HBBF commissioned a national laboratory recognized for its expertise in heavy metals analysis, Brooks Applied Labs (BAL) near Seattle Washington (http://brooksapplied.com/), to test 211 foods, including 145 samples of rice and 66 samples of other grains such as quinoa, couscous, and barley, for total recoverable arsenic, lead, cadmium, and mercury; and speciated arsenic for the rice samples.

BAL is accredited through the National Environmental Laboratory Accreditation Program (NELAP) and the International Organization for Standardization (ISO). It has also earned state accreditations for a variety of metals analyses, including arsenic and mercury. It uses the most current microwave digestion and ICP-MS technologies, and specializes in heavy metals testing (including arsenic, lead, cadmium, and mercury). BAL's clients include local governments, industry, the federal government, and engineering consulting firms. BAL specializes in low-level metal analysis, including analysis in food. It has tested a wide range of grains and other foods. Its sensitive methods can detect heavy metals in a wide range of food types, including grains, dairy, fruits and vegetables, and meat. For the heavy metals analyses used in this study, BAL is accredited according to the ISO 17025 standard. BAL's methods are comparable to FDA methods (FDA 2012,2015), with a notable difference: BAL achieves a lower limit of quantification (LOQ) for the analysis of inorganic arsenic than FDA. Other major analytical techniques are comparable: for example, both BAL and FDA rely on chromatography methods to separate arsenic species, and ICP-MS methods to detect heavy metals.

Sample preparation

Food receipt and storage: BAL received 211 food containers from May 2024 through March 2025, including rice and nine other grain types (see grain list in the main report). BAL logged in samples for the analysis of total recoverable arsenic [As], cadmium [Cd], lead [Pb], and mercury [Hg]. BAL received and stored all samples according to BAL Standard Operating Procedures (SOPs). Samples were stored at ambient temperature, maintaining the shipping temperature of the samples.

Sample homogenization: Samples were thoroughly homogenized prior to sample digestion. All equipment used for the homogenization process was pre-cleaned beforehand and subject to routine testing to ensure the accuracy of sample data.

Sample digestion: BAL prepared samples by the addition of hydrogen peroxide (H2O2) and concentrated nitric acid (HNO3) to a microwave digestion vessel, via method AOAC 2015.01, modified. BAL digested samples at a precise pressure and temperature in a controlled microwave digestion program.

Total metals analysis by AOAC 2015.01, Mod.

BAL developed method AOAC 2015.01, Mod (Heavy Metals in Food: Inductively Coupled Plasma-Mass Spectrometry) for analysis of total recoverable metals. The method was accepted as a First Action Method by the consensus standards developing organization AOAC. BAL analyzed total recoverable As, Cd, Hg, and Pb according to this method, using inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). The ICP-QQQ-MS method uses advanced interference removal techniques to ensure accuracy of the sample results. This technology allows for the removal of polyatomic and doubly-charged ions that can interfere with an isotope. This is a critical step for arsenic analysis, since arsenic is a monoisotopic element.

Arsenic speciation analysis

Sample digestion: BAL digested rice samples for arsenic speciation using a dilute acid solution. The digestion method typically induces conversion of As(III) to As(V) (This is also a characteristic of FDA's method.) Therefore, the accurate measurement resulting from this method is total inorganic arsenic (the sum of As(V) and As(III)), rather than results from individual valence states. Analysis of

arsenic speciation: Extracts from digestion were analyzed for total inorganic arsenic [InorgAs] (sum of As(III) and As(V)), monomethylarsonic acid [MMAs], and dimethylarsinic acid [DMAs] using ion chromatography inductively coupled plasma collision reaction cell mass spectrometry (IC-ICP-CRC-MS). This method uses chromatography to separate the different arsenic species and ICP-CRC-MS to detect the arsenic. The CRC is an interference reduction technology to remove polyatomic ions that can interfere with arsenic.

QA/QC and Certification

Quality Assurance and Quality Control: All analyses were conducted in accordance with BAL's Standard Operating Procedures. Each preparation batch also included four method blanks (BLKs), a certified reference material (SRM), a laboratory duplicate (DUP), and a matrix spike/matrix spike duplicate (MS/MSD) set. The sample results were reviewed and evaluated in relation to the QA/QC samples worked up at the same time. The BS recoveries, SRM recoveries, MS/MSD recoveries, and method blanks were evaluated against method criteria to ensure data quality.

BAL certification: BAL is ISO certified for elemental analyses (including arsenic, lead, cadmium, and mercury) and arsenic speciation analysis in food.

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APPENDIX C

Representative studies: Reduction of heavy metals in rice from home cooking methods

Background

The studies listed below include representative findings on how various home cooking methods can reduce levels of arsenic and other heavy metals in rice. Research consistently shows that cooking rice in excess water—then draining it—can significantly lower arsenic content. Based on its review of available studies and its own data, the FDA advises cooking rice in extra water - 6 to 10 parts water to 1 part rice, similar to cooking pasta - as an effective way to reduce inorganic arsenic.

Rice preparation methods investigated in the study	Rice type	Arsenic reduction (typically inorganic arsenic)	Study Findings	Details - Action and/or Findings	Rice sample origin (country and source)	References
Rinsing rice and cooking in extra water drained after cooking	White (polished) rice and other varieties	Up to 60%	FDA's review of published studies and its own research show that cooking rice like pasta can reduce 40 to 60 percent of the inorganic arsenic content, depending on the type of rice. FDA research also shows that rinsing rice before cooking has a minimal effect on the arsenic content.	Based on its review, FDA recommends to cook rice in 6 to 10 parts water to 1 part rice, drained after cooking.	Not specified.	FDA 2022
Various rinsing and water addition amounts: rinsing or no rinsing prior to cooking; cooking in extra water or cooking without extra water	Popular rice brands collected from households and markets in India	Up to 57%	Rinsing and cooking in excess water, drained after cooking, removed 57% of total arsenic, the most effective method investigated; rinsing and cooking in limited water removed 28% of total arsenic; and no washing or rinsing removed 0% of total arsenic. Approximately 50% of arsenic was lost in the rinse water, ~50% in the discard water.	Three major rice cooking practices commonly used worldwide were evaluated: (1) Rice washed thoroughly (5–6 times) until the rinse water runs clear, then boiled in excess water (5–6 times the weight of the raw rice), with the remaining water discarded after cooking; (2) Rice washed as in method (1), then boiled in a limited volume of water (1.5–2 times the weight of the rice) until fully absorbed; (3) Rice neither washed nor rinsed, cooked directly in 1.5–2 times its weight in water to complete absorption.	Twelve arsenic-contaminated raw rice samples were collected from arsenic-affected villages in West Bengal, India, along with three additional samples from a city market in Kolkata, India, for a total of 15 samples.	Sengupta 2006

Rice preparation methods investigated in the study	Rice type	Arsenic reduction (typically inorganic arsenic)	Study Findings	Details - Action and/or Findings	Rice sample origin (country and source)	References
Four methods: (1) rinsing, (2) cooking in a low water volume (2.5:1 water:rice), (3) cooking in a high water volume (6:1 water:rice), and (4) steaming	Basmati, long-grain, white and brown	10% to 45%	Total and inorganic arsenic were reduced by 10% after rinsing basmatic rice, but less for other rice types; cooking long-grain and brown rice in extra water removed 35% and 45% of total and inorganic arsenic, respectively; steaming did not consistently reduce total and inorganic arsenic in rice; and low volume water cooking did not remove arsenic.	Steaming reduced total and inorganic arsenic but not consistently across all rice types investigated. Cooking in extra water was the most effective step for arsenic removal.	Retails samples (basmati, brown, white) purchased in the UK.	Raab 2008
Cooking rice using a percolating method	White and brown rice	Up to 85%	Percolating technology—where cooking water, either free of or low in inorganic arsenic continuously flows through rice—is highly efficient at removing inorganic arsenic.	Six randomly selected wholegrain and white rice samples were prepared according to package instructions in a home setting, using quantities suitable for a large family, and cooked in an unmodified, off-the-shelf coffee percolator.	Market rice was purchased from major UK retailers in the city of Belfast, or purchased online through UK retailers.	Carey 2015
Rinsing in different amounts of water followed by different cooking methods (e.g., boiling with or without excess water)	White and brown rice	More than 60% for the most effective cooking method	Rinsing rice with arsenic-free water and boiling rice in excess water are both effective strategies for significantly reducing dietary arsenic intake. Significant decreases in total arsenic and inorganic arsenic, >60%, occurred when rice was rinsed and cooked in excess water. Boiling rice to complete absorption was least effective at removing total arsenic from rice.	Five distinct treatments were applied to both brown and white (polished) rice samples, incorporating varying rinsing volumes and cooking methods (boiling with or without excess water). The authors estimated that rinsing alone can reduce the health risk by 50%, while combining pre-rinsing with discarding excess water can reduce the risk by 83%.	Market basket rice samples from Ecuador and Spain.	Atiaga 2020
Post-harvest methods and cooking methods - polishing, parboiling, pH-dependent soaking, washing, cooking with different rice-to-water ratios	White and brown rice	Up to 80% for the most effective cooking method	Arsenic removal is 39–54% with parboiling, 38–55% with polishing (compared to whole-grain rice), 37–63% with soaking, and 6–80% with washing and cooking. The percent reduction is heavily influenced by the rice variety and type, i.e., rough (with husk), husked (without husk/brown), or polished rice.	This review article examines a range of post-harvest (dehusking, parboiling, and polishing), pre-cooking (washing and soaking), and cooking strategies (varying rice-to-water ratios) to assess their effectiveness in reducing arsenic levels in cooked rice. The authors provide a comprehensive overview of the advantages and limitations of each post-harvest treatment in mitigating both total and inorganic arsenic content.	Various (review of various studies).	Gupta 2023

Rice preparation methods investigated in the study	Rice type	Arsenic reduction (typically inorganic arsenic)	Study Findings	Details - Action and/or Findings	Rice sample origin (country and source)	References
Two methods: (1) Boiling water, adding rice and cooking for 5 min, pouring off water and cooking using the absorption method (also known as parboil and absorb), and (2) cooking rice in extra water drained after cooking.	White, brown, and parboiled basmati rice	>50% inorganic arsenic reduction for white and brown rice with the most effective cooking method	Cooking rice with extra water, and parboiling followed by cooking with all water absorbed, were equally effective in removing inorganic arsenic when water with little to no arsenic was used. Cooked brown rice has more essential nutrient elements (P, K, Mg, Fe, Zn, Mn, Cu, Se and Mo) compared to other rice types. Cooking methods significantly reduced levels of K, Fe, Cu and Mo.	The study investigated how different rice varieties (white, parboiled, and brown), cooking methods, and inorganic arsenic (iAs) content of cooking water influence the retention of iAs and essential nutrients (P, K, Mg, Fe, Zn, Mn, Cu, Se and Mo) in cooked rice. Cooking rice in excess water was more effective at removing iAs from parboiled rice (~50%) than the parboil and absorb method (39%).	White, brown, and parboiled Basmati rice obtained from a major UK supermarket.	Menon 2024
Rinsing rice and cooking in extra water drained after cooking	Popular rice brands in Bangladesh	33% arsenic, 35% lead, 27% cadmium	33%, 35%, and 27% average removal of arsenic, Cd, and Pb, respectively, from rice when cooked with a rice to water ratio of 1:6 after washing 5 times. Metal removal was increased by increasing the soaking time before cooking.	The influence of different cooking procedures on the removal of toxic elements including arsenic, cadmium, and lead along with other nutrient elements was investigated. Study included widely consumed brands in Bangladesh with various grain characteristics, e.g., aromatic, salt tolerant, etc.	Commercially available rice brands sold in Bangladeshi markets.	Shariar 2022
Washing, soaking (1, 5, 12 h), and then cooking using one of two techiques (1) excess water drained after cooking, and (2) "Kateh" (a Persian cooking method similar to absorption method with 1:2 water ratio by volume)	Popular rice brands collected from households in Tehran	The cooking methods investigated reduced both toxic metals and essential nutrients in rice	This study found that the method for cooking rice that balances the reduction of toxic metals with the preservation of essential nutrients involves washing, soaking for one hour, and then cooking in excess water discarded after cooking. The removal rate of all metals (toxic and essential) was highest when the rice was cooked using excess water as compared to the Kateh method. Levels of toxic metals (As, Cd, Pb) in rice from India were significantly higher than in rice collected from Iran and Pakistan.	Rice samples from 250 households across 22 districts in Tehran were collected. From these, the 10 most frequently consumed brands of rice grown in three countries—India, Iran, and Pakistan (30 samples of each brand)—were selected. Toxic metals included in the study were As, Cd, Pb, Fe, Zn, Co and Cu. For all rice types, washing or washing and soaking for 1 hour or 5 hours removed a greater proportion of essential nutrients (iron, copper, cobalt, and zinc) than arsenic, lead, or cadmium.	Popular brands of rice from households in Tehran; rice grown in Iran, Pakistan, and India.	Sharifi 2019

Rice preparation methods investigated in the study	Rice type	Arsenic reduction (typically inorganic arsenic)	Study Findings	Details - Action and/or Findings	Rice sample origin (country and source)	References
Rinsing rice and cooking in extra water drained after cookiong	White, brown, and parboiled rice	40% to 60%	Using excess water to cook rice reduced the average inorganic arsenic by 40% for long-grained white rice, 60% for parboiled rice and 50% for brown rice. Iron, folate, niacin, and thiamin were reduced by 50–70% in enriched polished and parboiled rice, while brown rice—which is not enriched—experienced significantly smaller losses of these nutrients.	The effects of rinsing and cooking methods on total arsenic (As), inorganic arsenic (iAs), iron (Fe), folate, niacin, thiamin, cadmium (Cd), and manganese (Mn) in rice were evaluated. Rinsing brown rice did not significantly reduce levels of As, Fe, folate, niacin, or thiamin. However, cooking brown rice in excess water reduced iAs by nearly 60%, with only a modest 5% loss of Fe, though it decreased vitamin content by approximately 50%. In contrast, rinsing polished rice—which is enriched with water-soluble vitamins—did not significantly reduce iAs, but led to substantial losses of Fe (90%) and vitamins (average 80%). Cooking unrinsed polished rice in excess water lowered iAs by an average of 51%, with smaller reductions in Fe (70%) and vitamins (50%) compared to rinsing.	Rice samples were obtained from grocery stores in and around College Park, Maryland, including two white long-grain varieties, two parboiled, one white medium-grain, and one brown long-grain variety.	Gray 2015
Four methods: (1) cooking without rinsing using the absorption method (cooking in just enough water), (2) rinsing for 5 minutes and cooking using the absorption method, (3) soaking for 3o minutes followed by absorption cooking, and (4) cooking in boiling water for 5 min, with water poured off (parboiling), then fully cooking using the absorption method	Thai brown rice, short grain brown rice, brown basmati, white long-grained rice, white pudding rice, sushi rice	Up to 73%	Parboiling and absorption was the most effective approach assessed, removing 54% and 73% of inorganic arsenic for brown and white rice, respectively.	Generally the treatments retained more nutrients in brown rice compared to white rice. No significant loss of Zn was observed in white or brown rice types; the loss of other nutrients was similar or less than reported losses from rice cooked in excess water previously published in the literature.	Rice types were purchased from major UK supermarket chains and online retailers.	Menon 2021+B6:H17

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