

Arsenic in 9 Brands of Infant Cereal

A national survey of arsenic contamination in 105 cereals from leading brands. Including best choices for parents, manufacturers and retailers seeking healthy options for infants.



IN PARTNERSHIP WITH



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Arsenic in 9 brands of infant rice cereal

Our findings show the urgency for action by parents, cereal makers, and FDA to get high-arsenic cereals off store shelves and out of infants' diets

EXECUTIVE SUMMARY

It's no secret that infants ingest traces of arsenic with every bite of rice cereal. Widespread reporting on the problem began five years ago, when tests by Consumer Reports found arsenic in rice and rice-based foods, including infant rice cereal. Rice readily absorbs arsenic from the environment, about 10 times more of it than other grains.

Widespread concern and public pressure – combined with growing science on arsenic's toxicity at low levels – should have spurred the U.S. Food and Drug Administration (FDA)

and the cereal industry to take high-arsenic cereals off store shelves. It hasn't happened.

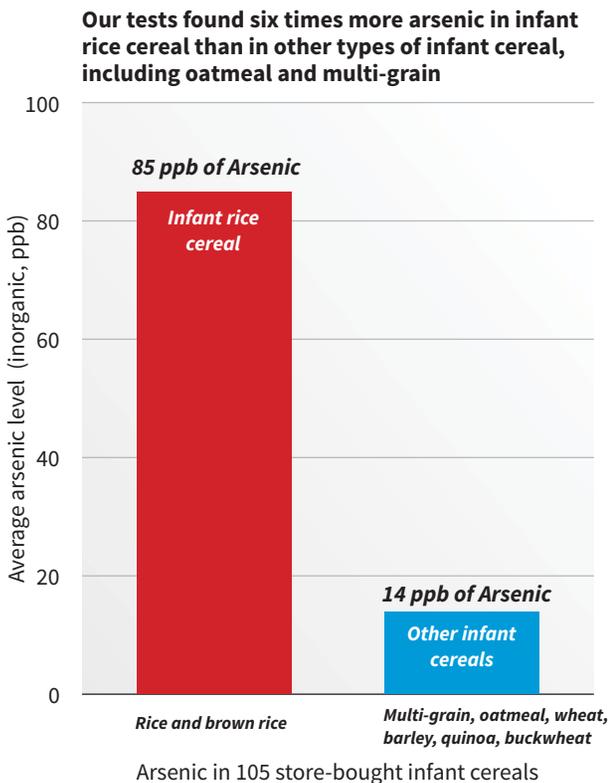
FDA is, in a word, stalled. More than a year after issuing its 2016 draft guidance to cereal makers – the culmination of four years of assessment – FDA is falling short of protecting infants. It has not set a final limit for arsenic in rice cereal. It has failed to finalize the proposed cap in its draft guidance, even though there is no known safe level of arsenic exposure.

Arsenic is strictly regulated in drinking water, but is legal in any amount in infant rice cereal. It is a potent human carcinogen and a neurotoxin shown to permanently reduce children's IQ.

A new study led by Healthy Babies Bright Futures (HBBF) helps parents navigate the gaps. HBBF's tests of 105 infant cereals show that non-rice and multi-grain varieties on grocery shelves nationwide – including oatmeal, corn, barley, quinoa, and others – contain 84 percent less arsenic than leading brands of infant rice cereal, on average. These alternate cereals include reliable and affordable choices for parents seeking to reduce infants' exposures to arsenic.

We tested infant cereal made by Gerber, Earth's Best, Beech-Nut, Nestlé, and five other brands. All but one of the 42 containers of infant rice cereal we tested had more arsenic than any of the 63 other cereals included in our study.

HBBF's tests are the first published results for arsenic in infant cereals that are made from some increasingly available alternate grains – including gluten-free, sprouted, and nutritious "superfood" grains. We tested cereals made from oats, corn, barley, quinoa, wheat, amaranth, millet, sorghum, flax, buckwheat, and rye.



HOW TO LOWER YOUR CHILD'S ARSENIC EXPOSURE

Choose these infant cereals instead of rice cereal: oatmeal, mixed grain, quinoa, barley, buckwheat, and wheat. Our tests found low arsenic levels in all brands tested.

Cost-saving tip: Oatmeal and multi-grain infant cereals are just as affordable as rice cereal.

Avoid rice snacks. They have high arsenic levels, too.

Does your family eat rice? Cook rice in extra water that you pour off before eating to reduce arsenic. For the lowest levels, buy basmati rice grown in California, India, and Pakistan. Better yet, try other grains, like quinoa and farro.



Our study uncovered some good news. Our results suggest that cereal makers have taken steps to limit arsenic. We found 85 ppb of arsenic, on average, in rice cereals tested in 2016 and 2017, versus the 103 ppb average level FDA found in 2013 and 2014. Still, rice cereals contain too much arsenic. Among expected health impacts from arsenic in rice cereal are increased cancer risk and harm to neurological development. Our tests show that rice cereals contain consistently higher amounts of arsenic – six times higher on average – than mixed grain and non-rice cereals.

**HEALTH COST:
DIMINISHED INTELLIGENCE FOR CHILDREN**

HBBF commissioned a new economic analysis to accompany our laboratory tests. It includes a comprehensive review and new analysis of IQ loss attributed to arsenic in infant rice cereal and other rice-based foods.

The findings underscore the urgency for action by cereal makers and FDA to get high-arsenic cereals off store shelves. The research team at Abt Associates, a nationally recognized toxicology and economic research group, estimates that arsenic in infant rice cereal and other rice-based foods accounts for an estimated loss of up to 9.2 million IQ points among U.S. children ages 0-6. This harm costs the country an estimated \$12-18 billion annually in lost wages, the result of IQ being diminished across the workforce from ubiquitous, early-life exposure to arsenic in rice (Abt 2017).

Arsenic is known to cause lung, bladder, and skin cancer, but arsenic in infant rice cereal also poses a threat to the developing brain. In the peer-reviewed scientific literature, at least 13 studies link arsenic to IQ loss and other neurodevelopmental impacts for children exposed in utero or during the first few years of life (Rodriguez-Barranco 2013).

Arsenic in rice: The impact to children's learning ability and the economy

9.2 million IQ points lost
children 0-6 years old

LOST LIFETIME EARNINGS
\$12-18 billion
annual cost for the US

SOURCE: ABT 2017

Widespread exposure to arsenic in infant rice cereal, like children's exposures to lead, shifts the population-wide IQ curve down. It nudges more children into special education, and ratchets down the IQ of the most creative and intellectually gifted children. For an individual child, the harm appears to be permanent (Wasserman 2007 and 2016, Hamadani 2011).

**RICE CEREAL:
INFANTS' TOP SOURCE OF ARSENIC**

Rice, in contrast with other grains, readily absorbs and concentrates arsenic from soil and water. It concentrates about 10 times more arsenic than other grains used in infant cereals. Rice is also grown where arsenic is abundant, magnifying the problem. Rice in the southern U.S. is often planted in old cotton fields, where (now banned) arsenic pesticides were sprayed for decades. Fertilizer contributed as well, when it included chicken waste laced with growth-

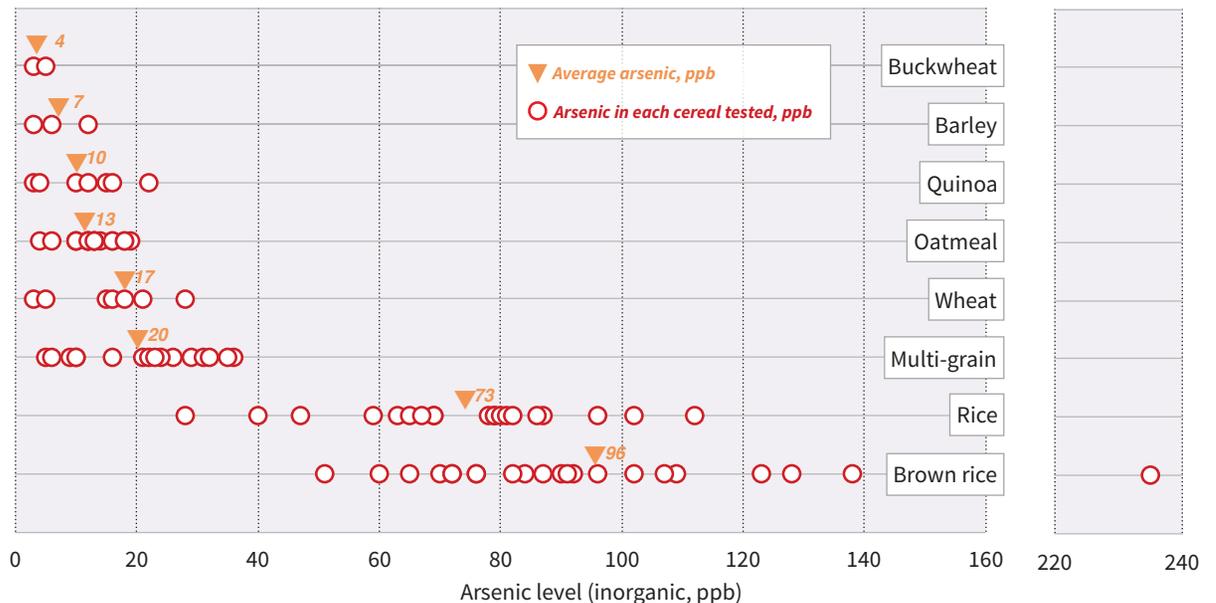
promoting arsenic additives (now mostly banned) that were routinely fed to the birds. Rice is also often cultivated in flooded fields; under these conditions, arsenic is prevalent in its most toxic (trivalent) form, the form most easily accumulated by rice.

With so many factors boosting arsenic uptake in rice, it's no surprise that infant rice cereal contains high levels.

Arsenic is ubiquitous in soil and water, and contaminates many foods. But infant rice cereal is the major source of arsenic for infants, accounting for 55 percent of their total dietary exposure (Shibata 2016). Sixty-four percent of infants four to six months old have been served rice cereal. Eighty percent eat it by their first birthday. The amount of arsenic is considerable: infants who eat rice cereal have 3.3 times more arsenic in their urine than infants with a rice-free diet (Karagas 2016).

Fortunately, many lower-arsenic cereals are affordable. For example, retailers offer Gerber and Earth's Best infant oatmeal and multi-grain cereals for the same price as their rice cereal.

Infant rice cereal consistently higher in arsenic:
All but one rice cereal we tested - 41 containers altogether - had more arsenic than any of the 63 non-rice and multi-grain cereals tested.
Arsenic in 105 store-bought infant cereals



INFANT CEREALS PURCHASED FOR THE STUDY: BRANDS, GRAINS, AND STORES

We selected 105 individual containers of 45 different cereals for testing, sold under nine brand names and made from 13 grains. Testing was performed at Brooks Applied Labs in Bothell, Washington. Multi-grain and non-rice cereals had far less arsenic than the rice cereals we tested.

9
cereal brands



45
unique cereal products



105
separate containers



13
grains



14 metropolitan areas and 15 retail chains where cereal were purchased:

- supermarkets
- dollar stores
- baby stores
- superstores



RECOMMENDATIONS

Cereal Companies

Our research shows that cereal makers need to take immediate steps to reduce arsenic in their cereals. This action is especially needed to protect infants who rely on cereal as a staple food.

Solutions suggested by FDA and other experts include sourcing rice from fields with lower arsenic levels in soil, growing it with natural soil additives that reduce arsenic uptake by the roots, growing rice strains less prone to arsenic uptake, preparing rice with excess water that is poured off, and blending it with lower arsenic grains in multi-grain products.

We found no evidence to suggest that any brand has reduced arsenic levels in rice cereal to amounts comparable to those found in other types of cereal, despite at least five years of significant public attention to the issue that has included widespread consumer alerts and a proposed federal action level (Consumer Reports 2012 and 2014, FDA 2016c).



FDA

FDA should act immediately to set an enforceable, health-based limit for arsenic in infant rice cereal and other rice-based foods. The limit should protect infants from both cancer and neurological harm.

In setting its 2016 proposed action level, the agency did not consider IQ loss or other forms of neurological impact, allowed cancer risks far outside of protective limits, and failed to account for children who have unusually high exposures to arsenic in rice (HBBF 2016).

Our study suggests that rice cereal makers can achieve a far lower, more health-protective limit than FDA's current proposal. Our tests found arsenic levels in rice cereal as low as one-fifth the amount FDA has proposed as its action level. Rapid action by FDA to set a protective level will protect children from arsenic-contaminated rice.



Parents

Parents who include infant rice cereal in their baby's diet can immediately lower their child's arsenic exposures simply by switching to oatmeal, multi-grain, and other non-rice cereals. Many of these alternate cereals also contain added iron; in an infant's diet, they can replace iron otherwise supplied by fortified rice cereal. Some are as affordable as rice cereal, including common brands of oatmeal and multi-grain cereals.

We recommend that parents avoid infant rice cereal. Non-rice and multi-grain alternatives have consistently lower arsenic contamination, and are a healthier choice.

STUDY METHODOLOGY AND FINDINGS

HBBF and a national, volunteer network of 11 other non-profit organizations purchased infant cereals from stores in 14 metropolitan areas across the country. We purchased cereals from 15 retail chains - supermarkets, dollar stores, baby stores, superstores and two online-only retailers.

We commissioned a nationally recognized laboratory with expertise in arsenic analysis, Brooks Applied Labs (BAL) near Seattle Washington (<http://brooksapplied.com/>), to test for arsenic in the 105 cereal containers included in this study. Laboratory analyses and quality control procedures are described in Appendix B. Our analysis of test results showed:

All brands and types of infant rice cereal contained more arsenic than non-rice and multi-grain cereals.

We found more arsenic in all but one of the 42 rice cereals tested than in any of the 63 containers of non-rice and multi-grain infant cereals included in our study. Arsenic levels in infant rice cereal averaged six times higher than in oatmeal, multi-grain, quinoa and other non-rice infant cereals. Test results, including results by brand, are included in Appendix A.

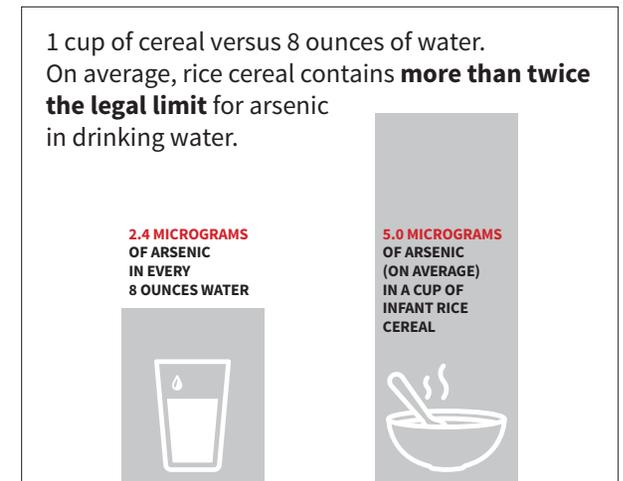
Infant Rice Cereal – Six times more arsenic than other cereals tested, on average. Six brands of infant rice cereal were tested: Gerber, Beech-Nut, BioKinetics, HappyBABY, Earth's Best, and Healthy Times.

Other Infant Cereals – Lower levels or no detectable arsenic. Nine brands of non-rice and multi-grain cereals were tested: All six brands listed above, plus NurturMe, Little Ducks, and Nestlé.

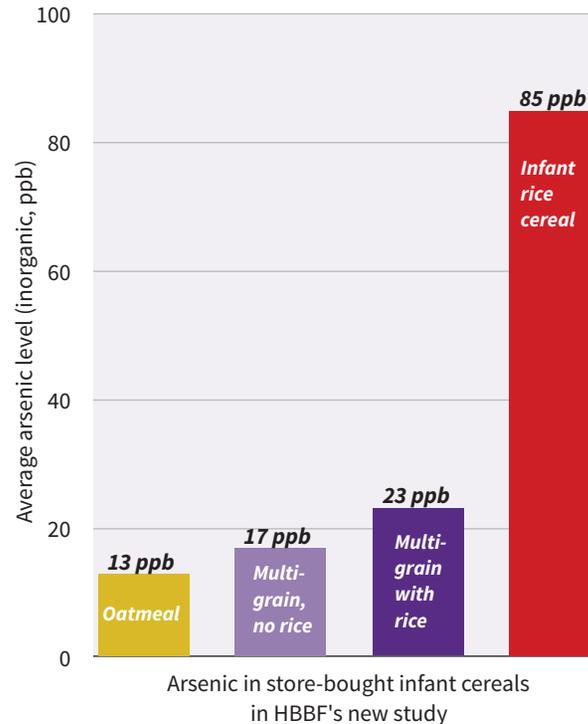
A cup of prepared infant rice cereal has more than double the amount of arsenic allowed in a cup of water:

With its legal limit of 10 parts per billion for arsenic in drinking water, the U.S. Environmental Protection Agency (EPA) allows 2.4 micrograms of the toxin in every cup (8 ounces) of water. A cup of infant rice cereal contains more than twice that amount – 5.0 micrograms of arsenic, on average, based on FDA's cereal tests (FDA 2016c).

The 10 ppb regulatory limit for arsenic in water isn't perfectly safe: It is set to reduce cancer risk, not neurological harm. It allows a 400 to 7,000 times higher risk than EPA's de minimis levels (Nachman and Ginsberg 2017), and is twice the 5 ppb limit originally proposed by EPA and adopted in New Jersey. A cup of rice cereal has over 4 times the amount that is legal in an 8-ounce glass of water in New Jersey.



Multi-grain infant cereals with rice contain less than one-third as much arsenic as infant rice cereal.



Multi-grain cereals, even those that contain rice, have far less arsenic than infant rice cereal, and are good choices for parents:

Shoppers participating in this study found oatmeal and multi-grain (with rice as an ingredient) to be the most widely available alternatives to infant rice cereal. In our tests, both were far lower in arsenic than infant rice cereal, for 41 of the 42 rice cereal containers we tested. Multi-grain cereals without rice had even less arsenic, just one-fifth the amounts found in infant rice cereal, but were less common in stores.



HEALTH RISKS – THE SCIENTIFIC EVIDENCE

Arsenic is a versatile poison, famously deadly at high doses but also harmful in trace amounts. Its rap sheet earns it a top spot on health agencies' lists of threats posed by the chemicals commonly found in Americans' bodies.

People exposed regularly to low doses of arsenic are more likely to suffer from cardiovascular disease, diabetes, respiratory problems, infections, and cancer, primarily skin, bladder and lung cancer. Adults and children exposed regularly can develop serious health conditions as arsenic blocks natural tumor-fighting hormones, interferes with immune cells, damages lung cells, and inflames heart cells. Among health agencies that classify it as a substance known to cause cancer in humans are the U.S. Environmental Protection Agency, the National Toxicology Program, and the International Agency for Research on Cancer.

New studies of arsenic's wide-ranging toxicity are published every year. Among them are studies finding 1.5-fold higher odds of skin cancer (squamous cell carcinoma) among people who eat rice versus those who don't, and research showing higher risks for long-lasting respiratory problems like wheezing – including breathing problems that need prescription medication – among babies whose mothers were exposed to higher amounts of arsenic during pregnancy (Gossai 2006, Farzan 2016).

But arsenic also targets the developing brain. Its ability to erode IQ in children make its presence in infant rice cereal uniquely risky. Infant rice cereal is a staple in children's diets, is high in arsenic, and is eaten daily at a time in life when the brain is intensely sensitive to chemical insult. This combination is a perfect storm of risk for babies.

Some infants face far higher risks than the average infant:

Arsenic in infant rice cereal and other rice-based foods poses a uniquely elevated risk for some children:

- Children with celiac disease often eat rice in place of gluten-containing grains. They ingest 14 times more arsenic than other children, on average (Munera-Picazo 2014, Abt 2017).
- Thirty percent of infants are given solid food before the age of four months, even though it is recommended that infants consume only breast milk in the first six months of life (Briefel 2004). Because their bodies are so small, they face higher risks than older infants from toxins like arsenic.
- Infants eat many different foods that contain arsenic, not just infant rice cereal. Twenty-four percent of infants ages 9-12 months drink apple juice, and 43 percent eat non-infant cereals that contain arsenic, for example. The health risks from arsenic in these foods add up (Siega-Riz 2010).
- National diet surveys show that Hispanic infants and toddlers are 2.5 times more likely to eat rice on a given day than other children (EPA 2008). Asian Americans eat nearly 10 times more rice than the national average (Potera 2007).

Rice cereal and other rice-based foods are not infants' only source of arsenic. Arsenic widely contaminates food, drinking water, playgrounds and backyards from its long-time use as a pesticide and outdoor wood preservative, and its release from mining and industrial operations. In some parts of the U.S. it occurs naturally at elevated levels in both soil and groundwater.

As a result, arsenic is a common contaminant in drinking water and many different foods. Children who drink water naturally high in arsenic face elevated risk. EPA estimated in 2000 that 36 million Americans drank water containing arsenic at or above the health-based limit proposed by public health advocates (3 parts per billion, NRDC 2017).

Arsenic is also commonly found in children: the federal Centers for Disease Control and Prevention (CDC) also finds it in the urine of 86 percent of children tested, in national biomonitoring surveys (deCastro 2014).

Of the many possible sources, however, infant rice cereal ranks first for most infants, according to national dietary surveys. It accounts for 55 percent of the total inorganic arsenic (the more toxic form of arsenic) infants ingest, on average (Shibata 2016).

ARSENIC AND IQ LOSS – 13 STUDIES, 7 COUNTRIES

At least 13 studies link arsenic to IQ loss and other neurodevelopmental impacts for children exposed in utero or during the first few years of life. They cover seven countries, including the U.S. Leading experts now classify arsenic as a substance known to cause neurological harm during development (Grandjean and Landrigan, 2006 and 2014). Multiple research teams and agencies have assessed its impact on IQ among children exposed to it through food and water (Rodríguez-Barranco 2013, Tsuji 2015, CalEPA 2008, Mass DEP 2011, Abt 2017).

Among evidence supporting arsenic's ability to harm the brain is a 2014 assessment of nearly 300 third to fifth graders in Maine, finding an average loss of 5-6 IQ points among those who drank well water contaminated with arsenic at or above 5 parts per billion. This level is common in some parts of the U.S., and is lower than the legal limit in public water supplies (10 parts per billion) (Wasserman 2014).

A new analysis by Abt Associates estimates a loss of 9.2 million IQ points among children ages 0-6, from arsenic in infant rice cereal and other rice-based foods (Abt 2017). This estimate is grounded in analyses from six research groups and health agencies, each of which developed or applied a mathematical curve (a "concentration-response function") to define the relationship between arsenic exposure and IQ loss for a child (Hamadani 2011, Tsuji 2015, CalEPA 2008, MassDEP 2011, Wasserman 2004, Wasserman 2007). All but one of these studies are free of financial conflict of interest.



The study with a conflict is funded in part by a coalition of industries, manufacturers, and agricultural producers with interests in the regulation of arsenic pollution (Tsuji 2015). Its methods yield an estimated to an estimated IQ loss at least 16-fold lower than any of the estimates derived from the independent studies.* Results from all independent studies correspond to millions of IQ points lost among children ages 0-6 who eat infant rice cereal and other rice-based foods. Estimates highlighted in this study are in the mid-range of the values derived from all six sources.

ARSENIC'S IRREVERSIBLE HARM

Studies find lasting impacts when children are exposed to arsenic early in life, including persistent IQ deficits in children two years after their polluted drinking water was replaced, cognitive deficits among school-age children exposed early in life, and neurological problems in adults who were exposed to arsenic-poisoned milk as infants (Wasserman 2007 and 2015, Hamadani 2011, Tanaka 2010). There is no evidence that the harm caused by arsenic is reversible.

THE LESS COMMON FORM OF ARSENIC IN INFANT CEREAL: SAFETY IN QUESTION

Our study focuses on inorganic arsenic, the form of arsenic that is best studied, widely recognized to be toxic, and dominant in infant rice cereal. But like other studies, our tests found another form of arsenic as well. On average, 39 percent of the total arsenic in infant rice cereal was the organic form of arsenic. While this form is considered less toxic than inorganic arsenic, there is little information on its safety early in life, when the body and brain are developing.

Organic arsenic is found in many foods commonly eaten by young children and pregnant women, including rice. It is easily transferred from mother to fetus across the placenta, and it crosses the blood-brain barrier in infants (EFSA 2009, Abt 2017). Further study of the safety of organic arsenic exposure during development is needed.

*Abt (2017) applies Tsuji's 2015 methods for estimating the arsenic-IQ relationship in scenarios labeled "Hamadani et al. (2011) Linear."

SAFETY STANDARDS FOR ARSENIC IN FOOD

Arsenic is on the EPA's short list of chemicals classified as known human carcinogens. It causes lung, bladder, and skin cancer, among other forms. In 2001 the agency slashed the legal limit for arsenic in drinking water, from 50 to 10 parts per billion. A year later, under pressure from the public and EPA, the outdoor wood industry announced a phase out of wood treated with an arsenic pesticide, used in nearly all outdoor wooden decks and playsets nationwide. With two major sources of arsenic in children's lives reduced, FDA had only to set limits for arsenic in food to tackle the remaining major exposure source. It has yet to do so.

Food safety guidelines in the U.S. include some provisions for arsenic. Because arsenic has been used in certain veterinary drugs, the federal government set maximum permissible levels of arsenic in eggs, uncooked edible tissues of chickens and turkeys, and some uncooked edible byproducts of swine. But currently, there is no enforceable limit for arsenic in rice or infant rice cereal (Shibata 2016).

In 2016 FDA published draft guidelines for industry that included an action level of 100 ppb for arsenic in infant rice cereal (FDA 2016c). This matches the standard set for all rice-based foods in the EU. But neither the FDA nor regulators in the EU established this limit based on a rigorous health assessment. And if FDA finalizes its action level, it will serve only as guidance to the infant cereal industry, not as a standard that FDA is required to enforce. Instead, FDA can choose whether or not to enforce an action level, at its own discretion.

FDA noted that the proposed action level could be met through "the use of current good manufacturing practice." In effect, it set its action level based on what it believes the industry can easily achieve, not on what would adequately protect children's health.

"Gold standards" for health protection can include, for example, limits that hold cancer risk to no more than one additional cancer in a population of one million (e.g., WHO 2001). Arsenic in rice outstrips that risk by 40 times: one in 25,000 people will develop lung or bladder cancer from

exposures to arsenic in rice-containing foods, according to FDA's estimates (FDA 2016a).

An economic analysis by Abt Associates shows that FDA's proposed standard leaves an unacceptably high economic and health burden for society. Infant rice cereal and other rice-based foods account for an estimated loss of 9.2 million IQ points among U.S. children ages 0-6, costing the country up to \$18 billion annually in lost lifetime earnings (Abt 2017). Were infants and children to eat other grains in place of infant rice cereal and other rice-based foods, the loss would be reduced by 84 percent.

Arsenic is known to cause cancer and pose risks to the developing brain. Rice cereal, often a baby's first food, combines contamination levels, toxicity, and exposure to a degree matched by few other infant foods. Setting a protective, health-based limit for arsenic in infant rice cereal presents an opportunity to make a significant difference in children's health.

REFERENCES

Abt Associates. 2017. Effects of Inorganic Arsenic in Infant Rice Cereal on Children's Neurodevelopment. Prepared for Healthy Babies Bright Futures.

AAP 2017 (American Academy of Pediatrics). Infant Food and Feeding. <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/HALF-Implementation-Guide/Age-Specific-Content/pages/infant-food-and-feeding.aspx>.

Briefel RR, Reidy K, Karwe V, Devaney B. 2004. Feeding infants and toddlers study: Improvements needed in meeting infant feeding recommendations. *J Am Diet Assoc.* 2004 Jan;104(1 Suppl 1):s31-7.

CalEPA 2008 (California Environmental Protection Agency). Inorganic arsenic reference exposure levels. Appendix D1. Office of Environmental Health Hazard Assessment. Retrieved from: http://oehha.ca.gov/air/toxic_contaminants/pdf_zip/arsenic_112508.pdf.

CR 2012 (Consumer Reports). Arsenic in your food: Our findings show a real need for federal standards for this toxin. *Consumer Reports Magazine*, Nov 2012. <https://www.consumerreports.org/cro/magazine/2012/11/arsenic-in-your-food/index.htm>.

CR 2014 (Consumer Reports). How much arsenic is in your rice? Consumer Reports' new data and guidelines are important for everyone but especially for gluten avoiders. *Consumer Reports Magazine*, Nov 2014. <https://www.consumerreports.org/cro/magazine/2015/01/how-much-arsenic-is-in-your-rice/index.htm>.

deCastro BR, Caldwell KL, Jones RL, Blount BC, Pan Y, Ward C, Mortensen ME. 2014. Dietary sources of methylated arsenic species in urine of the United States population, NHANES 2003-2010. *PLoS One.* 2014 Sep 24;9(9):e108098.

EPA 2008. Child-Specific Exposure Factors Handbook - Final Report. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=199243>.

European Food Safety Authority (EFSA). (2009). Scientific Opinion on Arsenic in Food. Parma, Italy.

FDA 2008 (U.S. Food and Drug Administration). Elemental Analysis Manual for Food and Related Products. Arsenic Speciation in Rice and Rice Products Using High Performance Liquid ChromatographyInductively Coupled Plasma-Mass Spectrometric Determination. <https://www.fda.gov/downloads/Food/FoodScienceResearch/LaboratoryMethods/UCM479987.pdf>.

FDA 2016a (U.S. Food and Drug Administration). Arsenic in Rice and Rice Products Risk Assessment Report. March 2016. <http://www.fda.gov/downloads/Food/FoodScienceResearch/RiskSafetyAssessment/UCM486543.pdf>. Accessed July 10 2016.

FDA 2016b (U.S. Food and Drug Administration). For Consumers: Seven Things Pregnant Women and Parents Need to Know About Arsenic in Rice and Rice Cereal. <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm493677.htm#3>. Accessed July 10 2016.

FDA 2016c (U.S. Food and Drug Administration). Draft Guidance for Industry: Inorganic Arsenic in Rice Cereals for Infants: Action Level. <https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm486305.htm>.

Farzan SF, Li Z, Korricks SA, Spiegelman D, Enelow R, Nadeau K, Baker E, Karagas MR. 2016. Infant Infections and Respiratory Symptoms in Relation to in Utero Arsenic Exposure in a U.S. Cohort. *Environ Health Perspect.* 2016 Jun;124(6):840-7.

Gossai A, Zens MS, Punshon T, Jackson BP, Perry AE, Karagas MR. 2006. Rice Consumption and Squamous Cell Carcinoma of the Skin in a United States Population. *Environ Health Perspect.* 2017 Sep 7;125(9):097005.

Grandjean P, Landrigan PJ. 2006. Developmental neurotoxicity of industrial chemicals. *Lancet.* 2006 Dec 16;368(9553):2167-78.

Grandjean P, Landrigan PJ. 2014. Neurobehavioural effects of developmental toxicity. *Lancet Neurol.* 2014 Mar;13(3):330-8.

Hamadani JD, Tofail F, Nermell B, et al. 2011. Critical windows of exposure for arsenic-associated impairment of cognitive function in pre-school girls and boys: a population-based cohort study. *Int J Epidemiol* 2011; 40: 1593-604.

Healthy Babies Bright Futures (HBBF) et al. 2016. Comments on the FDA's Proposed Action Level for Arsenic in Infant Rice Cereal. Docket: Inorganic Arsenic in Rice Cereals for Infants: Action Level; Draft Guidance for Industry; Supporting Document for Action Level for Inorganic Arsenic in Rice Cereals for Infants; Arsenic in Rice and Rice Products Risk Assessment: Report; Availability. Docket No. FDA-2016-D-1099. July 19 2016.

Karagas, M. R., Punshon, T., Sayarath, V., Jackson, B. P., Folt, C. L., & Cottingham, K. L. 2016. Association of Rice and Rice-Product Consumption with Arsenic Exposure Early in Life. *JAMA Pediatrics*, 170(6), 609-616.

Mass DEP 2011 (Massachusetts Department of Environmental Protection). Supporting Documentation for MassDEP Air Guidelines: Inorganic Arsenic and Compounds. Retrieved from: www.mass.gov/eea/docs/dep/toxics/types/arsenic-aaltel.doc

Munera-Picazo S, Ramirez-Gandolfo A, Burló F, Carbonell-Barrachina AA. 2014. Inorganic and total arsenic contents in rice-based foods for children with celiac disease. *Journal of Food Science* 79(1): T122-128, 2014.

Nachman KE, Ginsberg GL, Miller MD, Murray CJ, Nigra AE, Pendergrast CB. 2017. Mitigating dietary arsenic exposure: Current status in the United States and recommendations for an improved path forward. *Sci Total Environ.* 2017 Mar 1;581-582:221-236.

NRDC 2017 (Natural Resources Defense Council). What's in Your Drinking Water? Everything you need to know in order to fill a glass from your tap with confidence. <https://www.nrdc.org/stories/whats-your-drinking-water>.

Potera C. 2007. U.S. rice serves up arsenic. *Environ Health Perspect.* 2007 Jun;115(6):A296.

Rodríguez-Barranco M, Lacasaña M, Aguilar-Garduño C, Alguacil J, Gil F, González-Alzaga B, Rojas-García A. 2013. Association of arsenic, cadmium and manganese exposure with neurodevelopment and behavioural disorders in children: a systematic review and meta-analysis. *Sci Total Environ.* 2013 Jun 1;454-455:562-77.

Shibata T, Meng C, Umoren J, West H. 2016. Risk Assessment of Arsenic in Rice Cereal and Other Dietary Sources for Infants and Toddlers in the U.S. *Int J Environ Res Public Health.* 2016 Mar 25;13(4):361.

Siega-Riz AM, Deming DM, Reidy KC, Fox MK, Condon E, Briefel RR. 2010. Food consumption patterns of infants and toddlers: where are we now? *J Am Diet Assoc.* 2010 Dec;110(12 Suppl):S38-51.

Tanaka H, Tsukuma H, Oshima A. Long-term prospective study of 6104 survivors of arsenic poisoning during infancy due to contaminated milk powder in 1955. *J Epidemiol* 2010; 20: 439-4

Tsuji JS, Garry MR, Perez V, & Chang ET. 2015. Low-level arsenic exposure and developmental neurotoxicity in children: A systematic review and risk assessment. *Toxicology*, 337, 91-107.

Wasserman GA, Liu X, Parvez F, Ahsan H, Factor-Litvak P, van Geen A, Slavkovich V, Loiacono NJ, Cheng Z, Hussain I, Momotaj H, Graziano JH. 2004. Water arsenic exposure and children's intellectual function in Araihaazar, Bangladesh. *Environmental Health Perspectives*, 2004 Sep;112(13):1329-33.

Wasserman GA, Liu X, Parvez F, et al. 2007. Water arsenic exposure and intellectual function in 6-year-old children in Araihaazar, Bangladesh. *Environ Health Perspect* 2007; 115: 285-89.

Wasserman GA, Liu X, Loiacono NJ, Kline J, Factor-Litvak P, van Geen A, Mey JL, Levy D, Abramson R, Schwartz A, Graziano JH. 2014. A cross-sectional study of well water arsenic and child IQ in Maine schoolchildren. *Environ Health.* 2014 Apr 1;13(1):23.

Wasserman GA, Liu X, Parvez F, Factor-Litvak P, Kline J, Siddique AB, Shahriar H, Uddin MN, van Geen A, Mey JL, Balac O, Graziano JH. 2016. Child Intelligence and Reductions in Water Arsenic and Manganese: A Two-Year Follow-up Study in Bangladesh. *Environ Health Perspect.* 2016 Jul;124(7):1114-20.

WHO 2001 (World Health Organization). Water quality: Guidelines, standards and health. Assessment of risk and risk management for water-related infectious disease. Chapter 10. http://www.who.int/water_sanitation_health/dwq/whoiwa/en/.

APPENDIX A: LABORATORY TEST RESULTS

Results for analysis of inorganic arsenic in a variety of infant cereals are listed below. Testing was commissioned by HBBF and performed by Brooks Applied Labs in Bothell, Washington. Appendix B provides a summary of analytical methods.

Columns labeled 2016 and 2017 indicate the year that each cereal was purchased and tested. The qualifier “<” indicates that the arsenic concentration was below the method detection limit, while “(J)” indicates that the arsenic concentration was near the method detection limit and was estimated.

A limited number of cereals were tested for some of the less common grains, but results corroborate findings from FDA’s limited testing (FDA 2016a) and from Consumer Reports’ 2014 tests of raw, non-rice grains (CR 2014), which detected low arsenic levels relative to amounts found in rice.

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
RICE								
Beech-Nut	Rice Baby Cereal	•		87	Rice	Rice flour	Boston, MA	Walmart
Beech-Nut	Rice Baby Cereal	•		67	Rice	Rice flour	Washington, DC	Giant
Beech-Nut	Rice Baby Cereal	•		102	Rice	Rice flour	Charlottesville, VA	Kroger
Beech-Nut	Complete Rice Single Grain Baby Cereal		•	78	Rice	Rice flour	Washington, DC	Giant
Beech-Nut	Complete Rice Single Grain Baby Cereal		•	65	Rice	Rice flour	Charlottesville, VA	Kroger
Beech-Nut	Complete Rice Single Grain Baby Cereal		•	69	Rice	Rice flour	Charlottesville, VA	Giant
Gerber	DHA Probiotic Rice Cereal	•		79	Rice	Rice flour	Albany, NY	buybuyBABY
Gerber	DHA Probiotic Rice Cereal	•		86	Rice	Rice flour	Atlanta, GA	Publix
Gerber	Organic Rice Cereal	•		47	Rice	Organic rice flour	Detroit, MI	Meijer
Gerber	Organic Rice Cereal		•	28	Rice	Organic rice flour	Charlottesville, VA	Kroger
Gerber	Organic Rice Cereal		•	40	Rice	Organic rice flour	Washington, DC	amazon.com
Gerber	Rice Cereal	•		59	Rice	Rice flour	Anchorage, AK	Carr's
Gerber	Rice Cereal	•		112	Rice	Rice flour	Oakland, CA	Smart & Final
Gerber	Rice Cereal	•		96	Rice	Rice flour	Houston, TX	Family Dollar
Gerber	Rice Cereal	•		82	Rice	Rice flour	San Diego, CA	Family Dollar
Gerber	Rice Cereal	•		80	Rice	Rice flour	Minneapolis, MN	Target
Gerber	Rice Cereal	•		81	Rice	Rice flour	Texas	Dollar General
Gerber	Rice Cereal	•		79	Rice	Rice flour	Seattle, WA	Safeway
Gerber	Rice Cereal		•	63	Rice	Rice flour	Washington, DC	Giant
Gerber	Rice Cereal		•	69	Rice	Rice flour	Charlottesville, VA	Kroger

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
BROWN RICE								
BioKinetics	Brown Rice Sprouted Baby Cereal	•		235	Brown rice	Organic sprouted brown rice flakes	Washington, DC	amazon.com
BioKinetics	Brown Rice Sprouted Baby Cereal		•	138	Brown rice	Organic sprouted brown rice flakes	Washington, DC	amazon.com
BioKinetics	Brown Rice Sprouted Baby Cereal		•	128	Brown rice	Organic sprouted brown rice flakes	Austin, TX	amazon.com
Earth's Best	Whole Grain Rice Cereal	•		90	Brown rice	Organic whole grain brown rice flour	Boston, MA	Walmart
Earth's Best	Whole Grain Rice Cereal	•		76	Brown rice	Organic whole grain brown rice flour	Washington, DC	drugstore.com
Earth's Best	Whole Grain Rice Cereal	•		72	Brown rice	Organic whole grain brown rice flour	Portland, ME	Hannaford
Earth's Best	Whole Grain Rice Cereal	•		96	Brown rice	Organic whole grain brown rice flour	Detroit, MI	Meijer
Earth's Best	Whole Grain Rice Cereal	•		70	Brown rice	Organic whole grain brown rice flour	Minneapolis, MN	Target
Earth's Best	Whole Grain Rice Cereal	•		92	Brown rice	Organic whole grain brown rice flour	Charlottesville, VA	Kroger
Earth's Best	Whole Grain Rice Cereal		•	76	Brown rice	Organic whole grain brown rice flour	Charlottesville, VA	Giant
Earth's Best	Whole Grain Rice Cereal		•	65	Brown rice	Organic whole grain brown rice flour	Washington, DC	Giant
Earth's Best	Whole Grain Rice Cereal		•	60	Brown rice	Organic whole grain brown rice flour	Washington, DC	Whole Foods
Gerber	Organic Brown Rice Cereal	•		84	Brown rice	Organic whole grain brown rice flour	Boston, MA	Walmart
Gerber	Organic Brown Rice Cereal	•		72	Brown rice	Organic whole grain brown rice flour	Albany, NY	Babies'R'Us
Gerber	Organic Brown Rice Cereal	•		109	Brown rice	Organic whole grain brown rice flour	Detroit, MI	Meijer
Gerber	Rice & Banana Apple Cereal	•		107	Brown rice with fruit	Whole grain rice flour	Atlanta, GA	Publix
Gerber	Rice & Banana Apple Cereal	•		82	Brown rice with fruit	Whole grain rice flour	Seattle, WA	Safeway
HappyBABY	Organic Probiotic Baby Cereal - Brown Rice	•		51	Brown rice	Milled organic whole grain brown rice	Albany, NY	buybuyBABY
HappyBABY	Organic Probiotic Baby Cereal - Brown Rice	•		91	Brown rice	Milled organic whole grain brown rice	Boulder, CO	Whole Foods
HappyBABY	Organic Probiotic Baby Cereal - Brown Rice	•		87	Brown rice	Milled organic whole grain brown rice	Washington, DC	drugstore.com
HappyBABY	Organic Probiotic Baby Cereal - Brown Rice	•		123	Brown rice	Milled organic whole grain brown rice	Minneapolis, MN	Target
Healthy Times	Brown Rice Cereal for Babies	•		102	Brown rice	Organic whole grain brown rice flour	Boulder, CO	Whole Foods
BARLEY								
Gerber	Barley Cereal		•	6 (J)	Barley	Pearled barley flour (contains wheat)	Washington, DC	BabiesRUs.com
Gerber	Barley Cereal		•	12 (J)	Barley	Pearled barley flour (contains wheat)	Charlottesville, VA	Walmart
Healthy Times	Barley Cereal for Baby		•	<3	Barley	Organic whole grain barley flour	Washington, DC	amazon.com

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
BUCKWHEAT								
BioKinetics	Buckwheat Sprouted Baby Cereal	•		5 (J)	Buckwheat	Organic sprouted buckwheat flakes	Washington, DC	amazon.com
BioKinetics	Buckwheat Sprouted Baby Cereal		•	<3	Buckwheat	Organic sprouted buckwheat flakes	Washington, DC	amazon.com
BioKinetics	Buckwheat Sprouted Baby Cereal		•	<3	Buckwheat	Organic sprouted buckwheat flakes	Austin, TX	amazon.com
MULTI-GRAIN								
Earth's Best	Whole Grain Multi-Grain Cereal	•		10 (J)	Multi-grain no rice	Organic whole grain barley flour, Organic whole grain oat flour, Organic whole spelt (wheat) flour	Anchorage, AK	Carr's
Earth's Best	Whole Grain Multi-Grain Cereal	•		36	Multi-grain no rice	Organic whole grain barley flour, Organic whole grain oat flour, Organic whole spelt (wheat) flour	Minneapolis, MN	Target
Earth's Best	Whole Grain Multi-Grain Cereal	•		26	Multi-grain no rice	Organic whole grain barley flour, Organic whole grain oat flour, Organic whole spelt (wheat) flour	Albany, NY	Babies'R'Us
Earth's Best	Whole Grain Multi-Grain Cereal	•		10 (J)	Multi-grain no rice	Organic whole grain barley flour, Organic whole grain oat flour, Organic whole spelt (wheat) flour	Seattle, WA	Safeway
HappyBABY	Organic Probiotic Baby Cereal - Multi-Grain	•		9 (J)	Multi-grain no rice	Milled organic whole grain oats, Organic amaranth, Organic quinoa	Washington, DC	drugstore.com
Little Ducks	Might Oats naked	•		5 (J)	Multi-grain no rice	Organic oat flour, Organic amaranth flour, Organic sorghum flour, Organic millet flour, Organic buckwheat flour, Organic flaxmeal	Boulder, CO	Whole Foods
Earth's Best	Whole Grain Mixed Grain Cereal, Apple Sweet Potato	•		31	Multi-grain no rice and fruit	Organic whole grain barley flour, Organic whole oat flour, Organic spelt (wheat) flour	Albany, NY	Babies'R'Us
Little Ducks	Mighty Oats 5 Ancient Grains Blueberry Cinnamon	•		10 (J)	Multi-grain no rice with fruit	Organic oat flour, Organic amaranth flour, Organic sorghum flour, Organic millet flour, Organic buckwheat flour, Organic flaxmeal	Charlottesville, VA	Kroger
Beech-Nut	MultiGrain Baby Cereal	•		24	Multi-grain with rice	Whole wheat flour, Oat flour, Rice flour	Washington, DC	amazon.com
Beech-Nut	Complete Multigrain Baby Cereal		•	16	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Rice flour	Washington, DC	Giant
Gerber	MultiGrain Cereal	•		23	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Oat flour, Rice flour, Whole grain rye flour, Pearled barley flour	Boston, MA	Walmart

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
Gerber	MultiGrain Cereal	•		29	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Oat flour, Rice flour, Whole grain rye flour, Pearled barley flour	Oakland, CA	Smart & Final
Gerber	MultiGrain Cereal	•		22	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Oat flour, Rice flour, Whole grain rye flour, Pearled barley flour	Atlanta, GA	Publix
Gerber	MultiGrain Cereal	•		23	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Oat flour, Rice flour, Whole grain rye flour, Pearled barley flour	Portland, ME	Hannaford
Gerber	MultiGrain Cereal	•		21	Multi-grain with rice	Whole grain wheat flour, Whole grain oat flour, Oat flour, Rice flour, Whole grain rye flour, Pearled barley flour	Detroit, MI	Meijer
Nestle	Nestum Infant Cereal 5 Cereals	•		6 (J)	Multi-grain with rice	Wheat flour, Barley flour, Oat flour, Rice flour, Degermed yellow corn flour	Washington, DC	amazon.com
Gerber	Multigrain & Apple and Sweet Potato	•		32	Multi-grain with rice and fruit	Whole grain wheat flour, Whole grain oat flour, Rice flour, Oat flour	Portland, ME	Hannaford
Healthy Times	Mixed Grain with Blueberries Cereal for Baby		•	35	Multi-grain with rice and fruit	Organic Whole Oat Flour, Organic Whole Grain Brown Rice Flour, Whole Grain Organic Barley Flour	Washington, DC	amazon.com
OATMEAL								
Beech-Nut	Oatmeal Baby Cereal	•		13	Oatmeal	Oat flour	Boston, MA	Walmart
Beech-Nut	Oatmeal Baby Cereal	•		13	Oatmeal	Oat flour	Washington, DC	Giant
Beech-Nut	Oatmeal Baby Cereal	•		19	Oatmeal	Oat flour	Charlottesville, VA	Kroger
Beech-Nut	Complete Oatmeal Whole Grain Baby Cereal		•	16	Oatmeal	Whole grain oat flour	Charlottesville, VA	Kroger
Beech-Nut	Sensitive Oatmeal Whole Grain Baby		•	14	Oatmeal	Whole grain oat flour	Washington, DC	amazon.com
BioKinetics	Oats Sprouted Baby Cereal		•	4 (J)	Oatmeal	Organic sprouted oat flakes	Washington, DC	amazon.com
Earth's Best	Whole Grain Oatmeal Cereal	•		12	Oatmeal	Organic whole grain oat flour	Detroit, MI	Meijer
Earth's Best	Whole Grain Oatmeal Cereal	•		10 (J)	Oatmeal	Organic whole grain oat flour	Minneapolis, MN	Target
Earth's Best	Whole Grain Oatmeal Cereal	•		10 (J)	Oatmeal	Organic whole grain oat flour	Seattle, WA	Safeway
Earth's Best	Whole Grain Oatmeal with Bananas	•		12	Oatmeal with fruit	Organic whole grain oat flour	Albany, NY	buybuyBABY
Gerber	Oatmeal Cereal	•		12	Oatmeal	Whole grain oat flour, Oat flour	Anchorage, AK	Carr's

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
Gerber	Oatmeal Cereal	•		16	Oatmeal	Whole grain oat flour, Oat flour	Houston, TX	Family Dollar
Gerber	Oatmeal Cereal	•		13	Oatmeal	Whole grain oat flour, Oat flour	San Diego, CA	Family Dollar
Gerber	Oatmeal Cereal	•		18	Oatmeal	Whole grain oat flour, Oat flour	Houston, TX	Dollar General
Gerber	Organic Oatmeal Cereal	•		12	Oatmeal	Organic whole grain oat flour	Atlanta, GA	Publix
Gerber	DHA Probiotic Oatmeal Cereal		•	6 (J)	Oatmeal	Whole grain oat flour	Washington, DC	Giant
Gerber	Oatmeal & Banana Cereal	•		13	Oatmeal with fruit	Whole grain oat flour	Portland, ME	Hannaford
Gerber	Oatmeal & Banana Cereal	•		18	Oatmeal with fruit	Whole grain oat flour	Seattle, WA	Safeway
Gerber	Oatmeal & Peach Apple Cereal		•	10 (J)	Oatmeal with fruit	Whole grain oat flour, Oat flour	Washington, DC	Giant
HappyBABY	Organic Probiotic Baby Cereal - Oatmeal	•		13	Oatmeal	Milled organic whole grain oats	Albany, NY	buybuyBABY
HappyBABY	Organic Probiotic Baby Cereal - Oatmeal	•		10 (J)	Oatmeal	Milled organic whole grain oats	Minneapolis, MN	Target
Healthy Times	Oatmeal Cereal for Baby	•		12	Oatmeal	Organic whole oat flour	Washington, DC	amazon.com
QUINOA								
BioKinetics	Quinoa Sprouted Baby Cereal	•		15	Quinoa	Organic sprouted whole grain quinoa	Washington, DC	amazon.com
NurturMe	Protein Packed Quinoa Organic Infant Cereal	•		4 (J)	Quinoa	Organic quinoa	Washington, DC	amazon.com
NurturMe	Protein Packed Quinoa Organic Infant Cereal	•		4 (J)	Quinoa	Organic quinoa	Washington, DC	amazon.com
NurturMe	Protein Packed Quinoa Organic Infant Cereal	•		<3	Quinoa	Organic quinoa	Washington, DC	drugstore.com
NurturMe	Protein Packed Quinoa Organic Infant Cereal	•		4 (J)	Quinoa	Organic quinoa	Portland, ME	Hannaford
NurturMe	Organic Baby Cereal, Quinoa + Apple	•		10 (J)	Quinoa with fruit	Organic quinoa	Washington, DC	amazon.com
NurturMe	Organic Baby Cereal, Quinoa + Apple	•		12	Quinoa with fruit	Organic quinoa	Washington, DC	drugstore.com
NurturMe	Organic Baby Cereal, Quinoa and Banana	•		16	Quinoa with rice and fruit	Organic quinoa, Organic rice flour	Washington, DC	amazon.com
NurturMe	Organic Baby Cereal, Quinoa and Banana	•		22	Quinoa with rice and fruit	Organic quinoa, Organic rice flour	Washington, DC	drugstore.com

Brand	Cereal	2016	2017	Arsenic Level (inorganic, ppb)	Infant cereal type	Grains listed on the container label or brand/retailer website	Metro area where purchased	Retailer
WHEAT								
BioKinetics	Wheat Baby Cereal	•		5 (J)	Wheat	Organic sprouted whole wheat flakes	Washington, DC	amazon.com
Gerber	Whole Wheat Cereal	•		16	Wheat	Whole grain wheat flour	Anchorage, AK	Carr's
Gerber	Whole Wheat Cereal	•		18	Wheat	Whole grain wheat flour	Washington, DC	amazon.com
Gerber	Whole Wheat Cereal	•		28	Wheat	Whole grain wheat flour	Boston, MA	Walmart
Gerber	Whole Wheat Cereal	•		15	Wheat	Whole grain wheat flour	Washington, DC	Giant
Gerber	Whole Wheat Cereal	•		28	Wheat	Whole grain wheat flour	Atlanta, GA	Publix
Gerber	Whole Wheat Cereal	•		21	Wheat	Whole grain wheat flour	Seattle, WA	Safeway
Nestle	Nestum Cereal Wheat and Honey		•	<3	Wheat	Wheat flour	Washington, DC	amazon.com

APPENDIX B: LABORATORY ANALYSIS – SUMMARY OF METHODS

BACKGROUND

HBBF commissioned a national laboratory recognized for its expertise in arsenic analysis, Brooks Applied Labs (BAL) near Seattle Washington (<http://brooksapplied.com/>), to test for arsenic in the 105 cereal containers included in this study.

BAL is accredited through the National Environmental Accreditation Program (NELAC), the Department of Defense (DOD), 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 (arsenic, cadmium, mercury, and lead). BAL's clients include local governments, industry, the federal government, and engineering consulting firms.

BAL specializes in low-level metal analysis, including arsenic analysis in food. It has tested a wide range of cereals and grains. Its sensitive methods can detect arsenic in a wide range of infant cereal types, including non-rice varieties with low arsenic amounts.

For the arsenic analyses used in this study, BAL is certified by NELAC and ISO. There is no method formally approved by FDA or EPA for the analysis of inorganic arsenic in food. BAL's method is comparable to a draft method published by FDA (FDA 2012), with two notable differences: 1) The extraction acid used by BAL gives optimum results specifically for rice and other cereals, according to tests of a range of acids and other solvents; and 2) BAL achieves a lower limit of quantification (LOQ) for the analysis of inorganic arsenic than FDA. Other major analytical techniques are comparable: both BAL and FDA rely on chromatography methods to separate arsenic species, and ICP-MS methods to detect arsenic.

PREPARATION

Cereal receipt and storage: BAL received eighty (80) dry infant cereal samples in June and July 2016. BAL logged in samples for the analyses of total recoverable arsenic (As) and arsenic speciation defined as arsenite [As(III)], arsenate [As(V)], inorganic arsenic (InorgAs) as the sum of As(III) and As(V), monomethylarsonic acid (MMAs) and dimethylarsinic acid (DMAs).

BAL received an additional twenty-five (25) dry infant cereal samples in August 2017, and logged in samples for the analysis of arsenic speciation defined as inorganic arsenic (InorgAs) as the sum of As(III) and As(V). Two additional samples of ready-to-eat cereal were received and tested. These results are not included in study findings presented in HBBF's report, because they are not directly comparable to the 105 dry infant cereals tested.

BAL received and stored all samples according to BAL Standard Operating Procedures (SOPs) and EPA methodology. Samples were stored at ambient temperature, maintaining the shipping temperature of the samples.

Cereal homogenization: BAL determined that the cereals were homogeneous upon receipt and no further homogenization was performed.

TOTAL RECOVERABLE ARSENIC ANALYSIS

Cereal digestion: BAL digested cereal samples via modified EPA Method 3050B with a mix of concentrated nitric acid, hydrochloric acid, and hydrogen peroxide for total recoverable arsenic.

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

ARSENIC SPECIATION ANALYSIS

Cereal digestion: BAL digested cereal samples for arsenic speciation using trifluoroacetic acid (TFA). The TFA digestion method typically induces conversion of As(V) to As(III) in the samples and matrix spikes and induces conversion of As(III) to As(V) in the blank spikes. (This is also a characteristic of the draft method published by FDA in FDA 2012.) 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 laboratory fortified blank (BS), a certified reference material (SRM), a laboratory duplicate (DUP), and a matrix spike/matrix spike duplicate (MS/MSD) set. Post-preparation spikes (PS) were also included in the arsenic speciation batches. 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, PS recoveries, and method blanks were evaluated against method criteria to ensure data quality.

BAL certification: BAL, an accredited laboratory, has certified that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. BAL is NELAP and ISO certified for total recoverable arsenic in food (biota), and ISO 17025 certified for arsenic speciation analysis in food (biota).



Healthy Babies Bright Futures (HBBF) is an alliance of scientists, nonprofit organizations and donors working to create and support initiatives that measurably reduce exposures to neurotoxic chemicals in the first thousand days of development.

Our efforts are inspired and supported by science and data, and designed to help restore the chance for a full life to children who would otherwise face brain-diminishing exposures to toxic chemicals beginning in utero.

Learn more at hbbf.org