Bite of Arsenic, with Kathryn Cottingham

Ashley Ahearn

Many organic foods and high-energy products are sweetened with brown rice syrup as an alternative to high-fructose corn syrup. Consumers who eat these products may be avoiding high-fructose corn syrup, but they also may be exposed to arsenic that's been absorbed by the rice plants from which the syrup is made. In this podcast, Kathryn Cottingham talks with host Ashley Ahearn about her recent market-basket study of products containing brown rice syrup and other rice-based ingredients. Arsenic was detected in all the products tested, although Cottingham cautions it's too soon to say what this means in terms of potential health effects.

AHEARN: It's *The Researcher's Perspective*. I'm Ashley Ahearn.

Many products, like baby formula and cereal bars, list brown rice syrup as a major ingredient. It's a sweetener that's used as an alternative to high-fructose corn syrup.

If you're consuming products with brown rice syrup, you may be avoiding high-fructose corn syrup, but you also may be exposed to arsenic.

Kathryn Cottingham is a professor of biological sciences at Dartmouth College. She and a team of researchers tested four dozen products containing brown rice syrup, and she joins me now by phone to talk about their findings, which were published in *EHP* this month.[i]

Hi, Professor Cottingham.

COTTINGHAM: Hello.

AHEARN: So, how many of these products had arsenic in them?

COTTINGHAM: All of these products we tested had measurable amounts of arsenic. The amounts varied, and the percent of inorganic arsenic varied, but I think everything we measured we could actually detect arsenic.

AHEARN: And we should be clear here, there are two different types of arsenic. Tell me about them.

COTTINGHAM: Yes, so one of the things that's come up about this paper is the difference between inorganic arsenic and organic arsenic. So, inorganic arsenic would be forms of arsenic that do not have carbon atoms as part of them, whereas organic forms of arsenic would have carbon atoms. And that, basically, is a signal of biological processing, and that's why we call it "organic."

AHEARN: Which type of arsenic did you find in the products you tested?

COTTINGHAM: We found both inorganic and organic arsenic. Surprisingly, most of the arsenic we found was inorganic, which is the better studied and more toxic form.

AHEARN: And when I hear "inorganic," is that the same kind of arsenic that's showing up in drinking water in Bangladesh and places like that?

COTTINGHAM: Exactly. It's the form that we know the most about when it's in water.

AHEARN: What are some of the health impacts we have associated with that type of arsenic?

COTTINGHAM: Inorganic arsenic in drinking water is known to be a non-threshold carcinogen, which basically means there's no safe level of exposure. Kinds of cancer associated with arsenic exposure in water includes skin, bladder, and lung cancer, but we also have a whole host of other effects, including cardiovascular effects, links to diabetes and metabolic disorders, and for infants and young children some evidence of effects on neural development and also immune function development.

AHEARN: How does the arsenic contamination that you might find in, say, groundwater in Bangladesh or to a lesser degree in places like Texas, New England, and the upper Midwest—how does that compare with the arsenic that you're finding in the products with rice that you tested?

COTTINGHAM: Much at least to my surprise, the levels of exposure are comparable for people drinking water near the U.S. EPA and WHO drinking water standard [of 10 μg/L]. That amount of arsenic that you get by drinking a liter or two of water that's at the current drinking water standard is actually similar to the amount that we're estimating people to be exposed to through food such as rice and rice products.

AHEARN: So, within the safety level but still pushing it?

COTTINGHAM: Definitely pushing it because current evidence suggests that the drinking water standards are probably too high and that we're probably having excess risk even with those standards.[ii]

AHEARN: So, how is this arsenic, these two forms of arsenic, making its way into the products you tested for your study?

COTTINGHAM: So, we are focusing particularly on the role of rice as an accumulator of arsenic from the environment. So, rice is grown in conditions which lead to arsenic being able to be taken up, but [rice] itself is actually very efficient at bringing arsenic into the cells and the plant tissues. [iii]

AHEARN: And why is brown rice particularly of interest?

COTTINGHAM: So, brown rice is of particular interest because most of the inorganic arsenic that's taken up by the rice plant gets put into the aleurone layer, which is the [outer] layer [of bran] that's polished off when brown rice becomes white rice. So in brown rice we have that concentration of inorganic arsenic that we don't find in white rice to the same extent.

AHEARN: So, does it follow that arsenic is potentially a problem for other types of rice-based foods and ingredients that maybe you didn't test?

COTTINGHAM: Yes, very much so. So, we focused on a type of rice product that had not been extensively studied in the past, but there is great data out there from a number of different research teams on arsenic concentrations in a variety of rice products including white rice, brown rice, rice milk, baby rices, and rice bran and rice germ.

AHEARN: And when we look at these certain types of products, who is the most vulnerable? Who's consuming these products?

COTTINGHAM: Rice and rice products are consumed by many, many people, but we're particularly concerned about people who have limited diversity to their diets. For example, infants and young children may not be eating very many things, particularly infants and toddlers who are consuming formulas that have organic brown rice syrup. They may not be consuming very many other foods.

Other populations we're particularly concerned about are those who may be consuming a gluten-free diet, where rice is replacing other grains, and potentially endurance athletes who use lots of the high-energy products that we tested in our study.

AHEARN: What are the biggest questions for you moving forward on this subject, and what are you excited to research in the future?

COTTINGHAM: I’m particularly interested in moving from documenting that there is arsenic in food to showing that that arsenic is bioavailable, that people are metabolizing that arsenic and are exposed to it, and then to quantifying what the health effects of that exposure might be. So, we and many other research teams have shown that arsenic in food is high, but what we now need to know is exactly what happens to that arsenic when it hits the body and how it’s metabolized and what that means in the long run for people’s health.

AHEARN: Tell me about the birth cohort study.

COTTINGHAM: So, we’re conducting a study called the New Hampshire Birth Cohort,[iv] which is led by Margaret Karagas at the Geisel School of Medicine here at Dartmouth, and this birth cohort is explicitly designed to look at not only the effects of low levels of arsenic exposure through groundwater but also through food. So, we’re following women through their pregnancies to estimate exposure prenatally through water and to some extent through food, and then we’re following the infants in the cohort quite extensively to look at their diets, their arsenic exposure, and then, funding permitting, we’d like to follow up and look at long-term effects for their immune function, for their cognitive development, and so on.

AHEARN: When your research came out it got a lot of media attention. Do you have any thoughts you want to share now about how your research was covered and what’s important to you going forward in terms of how this research is presented?

COTTINGHAM: I think one thing we can do a better job of is talking about what we mean by organic arsenic versus what we mean by organic foods. So, you know, organic foods meet particular standards for growing without herbicides and pesticides and reduced fossil-fuel inputs, those sorts of things, whereas organic arsenic is a form of arsenic that's basically biologically mediated that includes just both carbon and arsenic and other atoms within the molecules, and I think that distinction wasn't made clearly enough early enough.

AHEARN: And how about covering the extent of risk to this exposure and what the outcomes might be to the population?

COTTINGHAM: I think one thing that we really need to be clear about, both us and the media, is that we don't know the health effects at this point. We know that exposures based on grinding things up and measuring them in the chem lab are comparable to what we would see in drinking water, but we don't really know what that means for the body or for long-term health effects. And we're just starting to study that.

AHEARN: Professor Cottingham, thank you so much for joining me.

COTTINGHAM: It's been nice talking to you, Ashley, thank you.

AHEARN: Kathryn Cottingham is a professor of biological sciences at Dartmouth College.

And that's *The Researcher's Perspective*. I'm Ashley Ahearn. Thanks for downloading!

Ashley Ahearn, host of *The Researcher's Perspective*, has been a producer and reporter for National Public Radio and an Annenberg Fellow at the University of Southern California specializing in science journalism.

References and Notes

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[i] Jackson BP, et al. Arsenic, organic foods, and brown rice syrup. Environ Health Perspect 120(5):623–626 (2012); http://dx.doi.org/10.1289/ehp.1104619.
[ii] EPA. Proposed Arsenic in Drinking Water Rule: Regulatory Impact Analysis. EPA 815-R-00-013. Bethesda, MD:Abt Associates, Inc. (Jun 2000). Available: http://water.epa.gov/drink/info/arsenic/upload/2005_11_10_arsenic_prop_ria.pdf [accessed 25 Apr 2012].
[iii] Savant NK, et al. Silicon management and sustainable rice production. Advan Agron 58:151–199 (1996); http://dx.doi.org/10.1016/S0065-2113(08)60255-2. The reason for rice's particular efficiency at accumulating arsenic lies in arsenic's chemical structure, which is very similar to that of silicon. All plants take up silicon from soil, but their ability to do so varies by two orders of magnitude. Rice is at the top end of that efficiency spectrum, with silicon accounting for up to 10% of the plant's dry weight.
[iv] NIH. Project 4: Epidemiology, Biomarkers and Exposure Assessment of Metals [research grant]. Bethesda, MD:National Institutes of Health (updated 25 Apr 2012). Available: http://projectreporter.nih.gov/project_info_description.cfm?aid=7792448 [accessed 25 Apr 2012].