Institute for Agriculture and Trade Policy

Not So Sweet: Missing Mercury and High Fructose Corn Syrup

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Executive summary

We live in a truly global food system. Our system typically is geared more toward producing lots of cheap calories, and then selling those calories to consumers, than it is toward meeting other goals like reducing fossil fuel use or producing food that is healthy.

In stark relief, new science shows just how blind to healthfulness some processed food makers have been. Just published online in the journal, *Environmental Health* (http://www.ehjournal.net/home/), is a science commentary reporting that mercury was found in 9 of 20 samples of commercial high fructose corn syrup (HFCS), a common sweetener of foods and beverages. The HFCS came from three different manufacturers.

Mercury is a potent brain toxin that we know accumulates in fish and seafood, although diet is not the only route by which we are exposed. When babies are exposed to elevated mercury in the womb, their brains may develop abnormally, impairing learning abilities and reducing IQ. For these youngest children, the science increasingly suggests there may be no "safe" level of exposure to mercury.

And yet for decades an increasingly common ingredient in processed foods, HFCS, has been made using mercury-grade caustic soda.

Caustic soda (also known as sodium hydroxide or lye) and a number of other food industry ingredients are produced in industrial chlorine (chlor-alkali) plants. "Mercury-grade," also known as "rayon-grade" caustic soda, comes from chlorine plants still using an outdated 19th century technology that relies on the use of mercury.

While most chlorine plants around the world have switched to newer, cleaner technologies, some still rely on the use of mercury. These mercury cell plants may rival coal-fired power plants as sources of mercury "leaked" to the environment.

What has not been publicly recognized is that mercury cell technology can also contaminate all the food grade chemicals made from it, including caustic soda, as well as hydrochloric acid. It was unrecognized, that is, until the lead author of the *Environmental Health* study, a longtime environmental investigator of the Food and Drug Administration (FDA), thought to look into it.

What she found was that possible mercury contamination of these food chemicals was not common knowledge within the food industry despite the availability of product specification sheets for mercury-grade caustic soda that clearly indicate the presence of mercury (as well as lead, arsenic and other metals). Upon further investigation, she found mercury contamination in some commercial HFCS, which can be made from mercury-grade caustic soda.

Through this public scientist's initiative, the FDA learned that commercial HFCS was contaminated with mercury. The agency has apparently done nothing to inform consumers of this fact, however, or to help change industry practice.

Consumers likely aren't the only ones in the dark. While HFCS manufacturers certainly should have been wary of buying "mercury-grade" caustic soda in the first place, the food companies that buy finished HFCS and incorporate it into their processed food products may be equally unaware of how their HFCS is made, i.e., whether or not it is made from chemicals produced by a chlorine plant still using mercury cells. The HFCS isn't labeled "Made with mercury," just like contaminated pet foods, chocolates and other products have not been labeled "Made with melamine." Under current regulations, that information is not made available to either consumers or to companies further down the food supply chain.

When we learned of this gap in information, we set out to do the FDA's work for it. We went to supermarkets and identified brand-name products—mainly soft drinks, snack foods and other items mostly marketed to children—where HFCS was the first or second ingredient on the label.

We sent several dozen products to a commercial laboratory, using the latest in mercury detection technology. And guess what? We found mercury.

In fact, we detected mercury in nearly one in three of the 55 HFCS-containing food products we tested. They include some of the most recognizable brands on supermarket shelves: Quaker, Hunt's, Manwich, Hershey's, Smucker's, Kraft, Nutri-Grain and Yoplait.

No mercury was detected in the majority of beverages tested. That may be important since sweetened beverages are one of the biggest sources of HFCS in our diets.

On the other hand, mercury was found at levels several times higher than the lowest detectable limits in some snack bars, barbecue sauce, sloppy joe mix, yogurt and chocolate syrup. Although closer to the detection limit, elevated mercury levels were also found in some soda pop, strawberry jelly, catsup and chocolate milk. The top mercury detections are summarized in Table 3, on page 14 of the report. Results for all 55 products tested can be found in the Appendix.

Environmental mercury from chlorine plants, coal-fired power plants, dental offices and other sources have helped contaminate albacore tuna, swordfish and many of our favorite fish with mercury. Eating these fish has long been thought to be the most important mercury exposure for most people.

However, HFCS now appears to be a significant additional source of mercury, one never before considered. When regulators set safe fish consumption recommendations based on an understanding of existing mercury exposure, for example, they never built mercury-contaminated HFCS into their calculations.

HFCS as a mercury source is a completely avoidable problem. HFCS manufacturers don't need to buy mercury-grade caustic soda. And the chlorine industry doesn't need to use mercury cell technology. In fact, most chlorine plants in the U.S. don't use it anymore, as it is antiquated and inefficient.

While we wait for the FDA to do its job and eliminate this unnecessary and completely preventable mercury contamination, we have a few suggestions for what you as consumers and voters can do.

Currently, food manufacturers don't list on their products the source of HFCS and whether or not it is made from mercury-grade caustic soda. So call them. Make use of the toll-free numbers or Web sites on many packages, and let companies know you're not comfortable eating their product until you know exactly what is in it.

As voters, call your elected officials and ask them for hearings to find out why the FDA is not protecting us from mercury in HFCS.

Also, ask these officials to reintroduce legislation originally proposed by then-Senator Barack Obama a few years ago that will force the remaining chlorine plants to transition to cleaner technologies. Because even if they stop providing the caustic soda used for HFCS, their mercury pollution is still contaminating our food system as it falls on farm fields and waterways.

Introduction

The American diet has changed dramatically over the last generation. In particular, the prevalence of chemical or synthetic inputs to foods has skyrocketed, as has the quantity of such foods we consume.

One example is the substitution of HFCS for table sugar. High fructose corn syrup was introduced to the American market in 1967, and ever since, its consumption has exploded.[1] By 1984, Coca-Cola had transitioned to sweetening its sodas sold in the United States with HFCS instead of table sugar (sucrose); other beverage companies quickly followed suit.[2] Today, HFCS is found in a stunning array of processed foods: breads, cereals, breakfast bars, lunch meats, yogurts, soups and condiments, among many others. It is a cheap staple of the industry.

From 1970 to 1990, the rising intake of HFCS far exceeded the change for any other food or food group.[3] On average, Americans today consume about 12 teaspoons per day of HFCS, accounting for approximately 1 in 10 calories.[1]

Such a rapid transformation in the American diet raises important questions: What are the potential health impacts of HFCS consumption? What exactly is HFCS and where does it come from? And what additional risks to consumers may stem from the industrialized processes by which HFCS is made and used?

HFCS consumption

HFCS is used primarily for sweetened beverages like soda.[4] A 20-ounce bottle of Coca-Cola has about 17 teaspoons worth.[5] It's reasonable to assume that many Americans largely consume their HFCS in the form of sweetened beverages.

The "average" American drank 37 gallons of carbonated, non-diet soft drinks in 2004, but averages mask the fact that specific age groups can ingest much higher levels.[6]

According to *Liquid Candy*, a report by the Center for Science in the Public Interest, "Children start drinking soda at a remarkably young age, and consumption increases through young adulthood. One-fifth of one- and 2-year-old children consume soft drinks. Almost half of children ages 6 to 11 drank soda in 1994-96, averaging 15 ounces per day."[5] That's the equivalent of over 42 gallons annually.

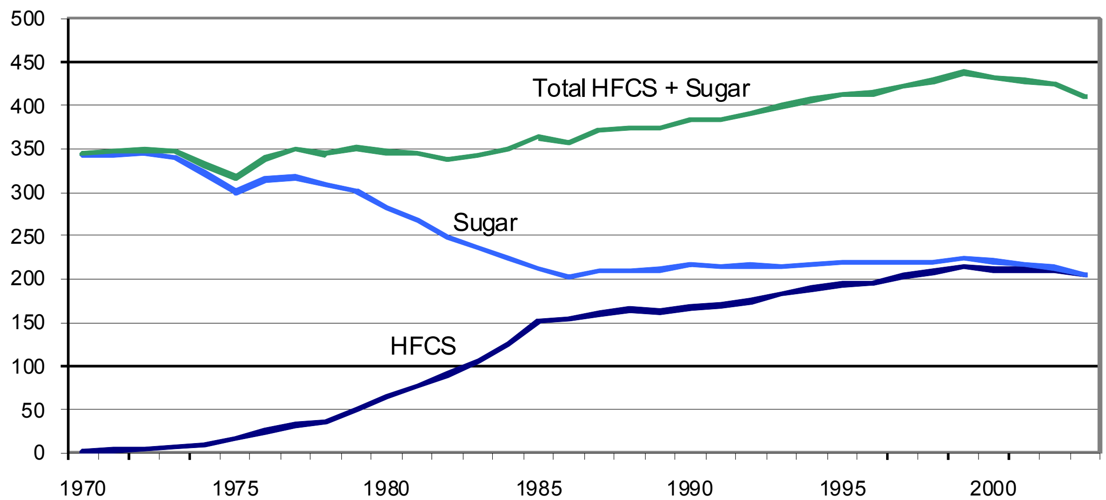
Teenagers drink a lot of soda as well. Teenage boys, ages 13 to 18, who drink soda average an estimated three or more cans a day (over 102 gallons annually). One in 20 drinks at least five cans per day (over 171 gallons annually).[5]

Of 13- to 18-year-old girls who drink soda, average intake is a little less than two cans a day (about 68 gallons annually), and 5 percent of them drink more than three cans a day (over 102 gallons annually).[5]

These data exclude the substantial amounts of sweetened *non*-carbonated drinks—e.g., sports drinks, synthetic fruit beverages, energy drinks, and so on—also consumed by kids, and typically containing zero to just 10 percent fruit juice.

In 1967, table sugar constituted 86 percent of caloric sweeteners consumed.[1] From 1967 to 2005, American consumption of caloric sweeteners—HFCS, honey and edible syrups (molasses, maple syrup), as well as table sugar—went up 24 percent, to just over 141 pounds per person per year. Just about the entire rise is due to HFCS, nonexistent prior to 1967.[1] Table sugar consumption actually dropped over that time.[1]

Figure 1: HFCS vs. Table Sugar (Sucrose) Consumption

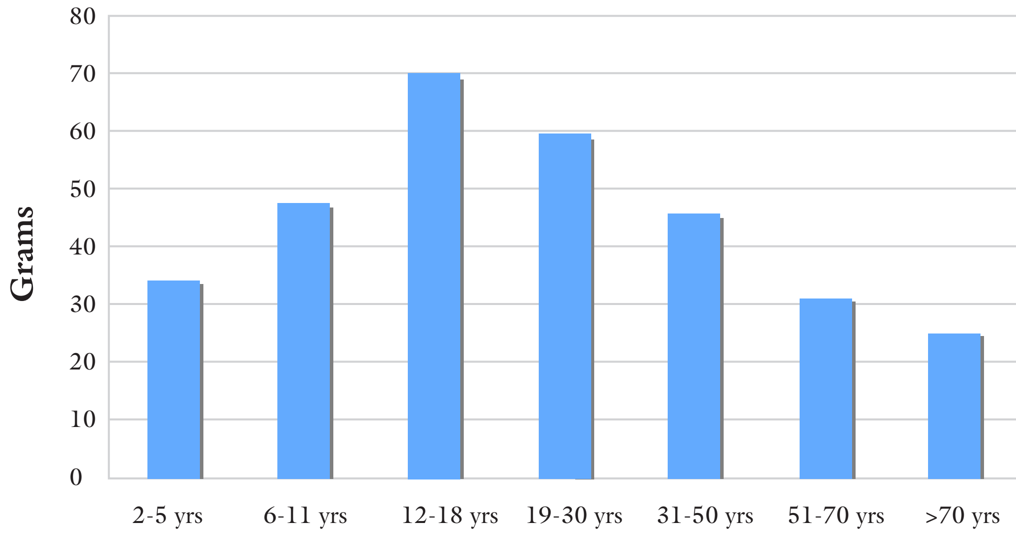


Source: Data from USDA ERS Briefing Room: Sugar and Sweeteners: Data Tables. Available at http://www.ers.usda.gov/Briefing/Sugar/. Graphic created by IATP.

By 2007, the average American consumed an estimated 40 lbs (dry weight) of HFCS each year—roughly 50 grams, or about 12 teaspoons worth each day.[7] The USDA derives this estimate from data it collects on the total yearly production of sweeteners, including HFCS.

Using data on fructose consumption patterns from more than 21,000 American adults and children collected as part of the third National Health and Examination Survey (NHANES), we also calculate that adolescents and young adults consume significantly more HFCS than "average." As reflected in Figure 2, American 19- to 30-year-olds consume about 60 grams of HFCS per day. For 12- to 18-year-olds, HFCS consumption is about 70 grams, or 40 percent more than a 50 gram per day "average."[8]

Figure 2: Estimates of Average Daily HFCS Consumption, by Age Grouping



Adapted from data from Tables 1 and 3 in Vos M, Kimmons J, et al. Dietary fructose consumption among US children and adults: The third national health and nutrition examination survey. *Medscape J Med*. 2008. Figures assume: 1) 60% of fructose came from HFCS; 2) a 50% fructose/50% glucose combination in HFCS as a conservative measure; 3) calculation of HFCS content excludes fruit, fruit juices and vegetables.

Those 37 gallons of carbonated, non-diet soft drinks the average American consumed in 2004 contained approximately 60,000 calories. The additional 16 gallons of fruit and sport drinks consumed brings the total to about 85,000 calories.[1] Many, if not most, are sweetened with HFCS.

Average HFCS intake translates to around 200 calories per day, or approximately 10 percent of the calories in the diet.[5] Higher-end HFCS consumers easily exceed 300 calories in daily HFCS calories. A recent survey of all the undergraduates at one college found they consumed an average of 543 calories worth of sweetened beverages per day, with the average African-American student ingesting a staggering 796 calories per day.[9]

Where is HFCS found?

In 2004, HFCS represented more than 40 percent of all caloric sweeteners added to beverages and foods.[10]

HFCS is a mixture of the common carbohydrates, fructose and glucose. The beverage industry alone uses roughly 60 percent of HFCS supplies—the vast majority of non-diet drinks are sweetened with HFCS. HFCS-55, the kind used by soft drink companies, is approximately 55 percent fructose and 45 percent glucose. By comparison, common table sugar (sucrose) is 50 percent fructose and 50 percent glucose.

The other 40 percent of HFCS supplies are used in food production, by commercial bakeries, fruit and vegetable canners, makers of candy, ice cream, yogurt and other dairy products, and fast food companies. At fast food restaurants, the salad dressings, sauces, buns, shakes, pies, rolls, breads, desserts, muffins and cookies all contain HFCS. Typically, they use HFCS-42, which is approximately 42 percent fructose and 58 percent glucose.

Why do food manufacturers use HFCS?

The sweetener industry claims a preference for HFCS due to its ability to help preserve foods, retain moisture and enhance other flavors.[11] For instance, because our taste buds detect the sweetness of HFCS early, and that sweetness doesn't linger, its incorporation into salad dressings helps to mellow the acid "bite" of vinegar while allowing the mouth to experience the fruity and spicy flavors of other ingredients more clearly.

Table 1: U.S. HFCS Consumption by Type of User Industry (thousand short tons)

Industry	2002	Percent
Beverages (mostly soft drinks)	5270.2	57.0
Canned, bottled, and frozen foods	685.7	7.0
Bakery, cereals and allied products	513.1	6.0
Ice cream and dairy products	258.5	3.0
Confectionery and related products	83.0	1.0
Total	9294.0	

Source: Beghin JC, Jensen HH. Farm policies and added sugars in US diets. Working Paper 08-WP 462. 2008. Iowa State University. Calculated from U.S. Census Bureau data available as of February 2008.[4]

Dufault et al., and the Corn Refiners Association report that HFCS is also used as a sweetener to enhance product shelf life—in other words, as a preservative.[11, 12] It is not known exactly how HFCS acts to preserve the color and texture of canned fruits or applesauce to "promote freshness" or to inhibit microbial spoilage and extend shelf life.

Under U.S. federal law, chemicals added to foods as preservatives are supposed to be FDA-approved for that purpose. Even though the industry highly touts and markets HFCS preservative qualities, it carries no such approval. That is because in 1996 the FDA determined that HFCS is Generally Recognized As Safe (GRAS). The GRAS designation basically says that although a food ingredient hasn't been completely studied or tested for safety, the FDA *a priori* considers it to be safe, putting the onus instead on the public to somehow marshal evidence after the fact that consumers have been harmed by it.

The FDA's regulations provide that GRAS ingredients must be reexamined in light of new scientific information.[13] The FDA has been petitioned with no response to reconsider HFCS status as GRAS, given the building evidence of its health impacts.[14]

HFCS and mercury

Most attention to HFCS lately, whether in the news or in the scientific literature, has been around its potential contribution to obesity and other diet-related disease. Increased consumption of calories has been a major driver of the obesity epidemic. This report deals with another health concern entirely: mercury contamination.

Just published in the peer-reviewed scientific journal, *Environmental Health*, is the bombshell that commercial HFCS appears to be routinely contaminated with mercury.[12] It turns out the contamination isn't so much accidental as newly recognized, given the fact that much HFCS has been made and continues to be made using "mercury-grade" caustic soda.

Caustic soda produced by a mercury cell process is contaminated with 0.2 to 0.3 parts per million (ppm) of mercury,[15] and perhaps as much as 1 ppm, in some cases.[16] Much HFCS is produced using exactly this same "mercury-grade" caustic soda. Mercury contamination of soft drinks or drink mixes made from this caustic soda was acknowledged by the National Association of Clean Water Agencies as early as 2000.[17]

Other common food ingredients derived from mercury cell chlor-alkali plants include citric acid and sodium benzoate, a food preservative found in many foods also containing HFCS. To our knowledge, these ingredients have not yet been tested for mercury contamination.

Other common household products made from caustic soda also may be contaminated with low ppb levels of mercury, including shampoo, toilet tissue, bleach and toothpaste.[17]

What is mercury-grade caustic soda?

Chlorine is a chemical building block used to make everything from vinyl blinds to lye. Since 1884, one process for producing chlorine has been to pump brine or saltwater through a vat of mercury, also known as a mercury "cell." These mercury cell chlor-alkali plants average 56 mercury cells each, with as much as 8,000 pounds of mercury per cell.[12] Today, the chlorine industry remains the largest intentional consumer (end user) of mercury.

The mercury in the plants is supposedly left behind and reused. But in fact mercury is highly volatile, and it is undisputed that contamination occurs throughout the process. These plants make not only chlorine, but a number of other products as well, including caustic soda (lye), sodium hypochlorite (bleach) and hydrochloric acid. Both the products of chlorine plants and the wastewater stream end up containing mercury residues.

Newer technology exists for making chlorine without mercury. In 2005, for example, 90 percent of U.S. chlorine production, but just 40 percent of European production, used membrane cell or diaphragm cell technology instead of mercury cells; 53 mercury cell chlor-alkali plants operate in the European Union.[18] Caustic soda destined for HFCS manufacture comes from either mercury cell or membrane cell plants, located in the U.S. or abroad.

Four chlor-alkali plants in the U.S. still rely on mercury cell technology. They are run by Olin Corporation, at two plants in Augusta, Ga., and Charleston, Tenn., Ashta Chemicals in Ashtabula, Ohio, and PPG Industries in New Martinsville, W. Va.[19,20] The Port Edwards, Wis., plant operated by ERCO Worldwide is in the process of converting to mercury-free technology.[21]

A longtime enigma of these plants has been their "missing mercury."[22] The nine mercury cell plants operating in 2003 reported consuming 38 tons of mercury, but emitting just eight tons into the environment. What happened to the other 30 tons? The plants cannot account for it.[22,23] The five mercury cell plants still in operation reported emitting more than 3,300 pounds of mercury into the environment in 2005.[20] Their unreported emissions of lost or missing mercury are likely to be far greater. One estimate is that unmonitored mercury releases from chlor-alkali plants may be nine times greater than the monitored emissions.[20]

Where does this missing mercury go? As mercury volatilizes during routine operations, it may end up in the plant's infrastructure, or on the grounds.[24] Since 1965, approximately 32 chlor-alkali plants have closed in the U.S. and of those sites, 14 are now Superfund sites and 27 are undergoing federally directed corrective action.[23] This month's *Environmental Health* study suggests that additional tons worth of missing mercury may end up as impurities in the plants' products, including those like caustic soda that are added to the food supply.

This finding only adds to the already compelling argument for eliminating mercury from chlor-alkali plants once and for all. In addition to avoiding mercury contamination of the environment and the food supply, newer technologies are more efficient. A report from the nonprofit organization, Oceana, notes:

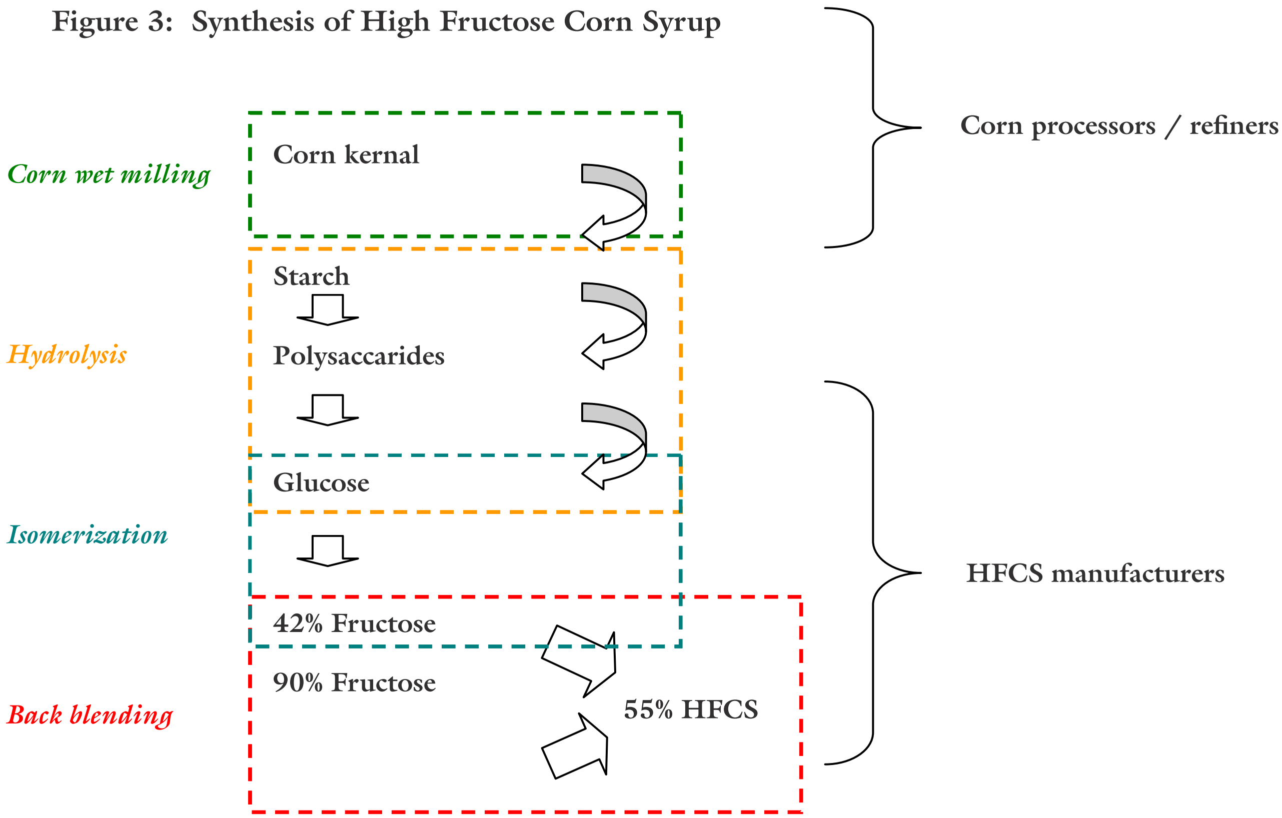
> Although the cost of converting to mercury-free technology runs in the millions of dollars (as detailed in the report), analysis shows the majority of costs would be recovered within five years from energy savings, increased capacity and eliminating millions of dollars in mercury-related fines, upgrades and treatment costs. Plants that have shifted see increases in energy efficiency between 25 and 37 percent. Since electricity can make up half of total production costs, this can vastly improve profitability. Many plants also have increased production capacity by approximately 25 percent in the process of converting to mercury-free technology.[20]

How is HFCS produced?

HFCS is synthesized in a highly specialized, industrial process using a number of enzymes and other inputs.[2] Either membrane-grade or mercury-grade caustic soda can be used. At the beginning of the process, caustic soda helps separate the corn starch from the corn kernel. Along with hydrochloric acid, it also is used throughout the process to maintain a pH balance.

Mercury-contaminated caustic soda can contaminate whatever food or other products are made from it, like HFCS. Indirectly, it also can contaminate the final food products to which HFCS is added.

Figure 3: Synthesis of High Fructose Corn Syrup



Corn processors, like ADM or Cargill, separate the cornstarch from the kernel. Cornstarch is converted into corn syrup through a process called acid hydrolysis. The wet starch is mixed with weak hydrochloric acid, pressurized and heated to help break down the starch molecules. A genetically modified enzyme, alpha-amylase, breaks the starch into shorter chains of sugar called polysaccharides. (After this stage, corn processors typically ship the starch to HFCS manufacturers.)

HFCS manufacturers then treat the starch (polysaccharides) using another genetically modified enzyme, glucoamylase, resulting in glucose. The mixture is passed over columns of a third enzyme, converting a portion of the glucose into fructose. The result is HFCS, which is comprised of approximately 42% fructose, 52% glucose, and 6% higher saccharides—known as HFCS-42. Caustic soda is used for various reasons throughout the process.

A separate process can boost fructose content to 90% HFCS. Then, "back blending" with the original 42% mixture can yield syrups with 55% fructose, also known as HFCS-55. This was the mixture adopted by the carbonated beverage industry beginning in 1984.

Mercury and public health

Mercury is a heavy metal with the potential to damage many organ systems, including the heart, immune and nervous systems. Mercury is toxic in all of its various forms.

The very young are especially vulnerable. When babies are exposed to elevated methylmercury in the womb, their brains may develop abnormally, impairing learning ability and reducing IQ. Children are thought to be at risk for these effects even at the levels of methylmercury exposure currently found in the population. That's why for many years there have been fish advisories recommending young children and women of childbearing age in particular to limit consumption of fish species known to have elevated methylmercury.[27]

Just like with environmental lead, methylmercury exposure levels considered “safe” for the very young have continued to fall as scientists have gotten better at measuring long-term effects. It’s not that mercury has become less safe, we have just become a lot smarter about mercury.

Recent evidence suggests that perhaps no developmental exposure to methylmercury can be considered safe, because of the sensitivity of the developing brain.[27] Mercury contamination of the food supply, therefore, is especially concerning since a mother’s diet can deliver mercury during critical phases of brain development directly to the fetus via the placenta, or to the infant via breast milk.

In the *Environmental Health* report, Dufault et al. found among 20 samples of commercial HFCS detectable levels of total “mercury ranging from below a detection limit of 0.005 to 0.570 micrograms mercury per gram of high fructose corn syrup.” Nine of the samples had measurable total mercury.

Using the USDA’s estimate of 50 grams of average consumption HFCS per day, one might roughly estimate potential total mercury ingestion via HFCS of up to 28.5ug total mercury/day (50 grams HFCS X 0.570 ug/g). Using these same assumptions, high-end HFCS consumers potentially could have much higher total mercury ingestion.

It is difficult to know to what to compare this figure. The EPA has established a “reference dose,” or maximum recommended dietary intake of *methylmercury*. Methylmercury is the form typically found in fish and seafood. The reference dose of 0.1 ug/kg/day applies to women of childbearing age and young children, who are thought to be the most at risk from methylmercury exposure. For the “average” 55 kg American woman, this would translate into no more than 5.5ug/day of methylmercury.

There is no reference dose for total mercury. The mercury found in HFCS may be a different form of mercury than the methylmercury typically found in fish (we just don’t know), but it poses a risk just the same. Mercury in any form can be toxic to the developing brain.[28]

And whatever the source or species, mercury can accumulate in the brain or other tissues of the body, causing cumulative impacts over time. Contamination of HFCS with total mercury therefore adds to an already existing problem of methylmercury exposure from seafood consumption—an exposure estimated to put hundreds of thousands of fetuses every year at risk of harm from their mothers’ exposure.[27]

Americans’ daily ingestion of HFCS also means that mercury exposures will happen routinely and possibly throughout a person’s entire lifetime, beginning pre-conception and continuing *in utero* and onwards.

Why we tested brand-name foods for mercury

From the new *Environmental Health* report, we know commercial HFCS is often mercury-contaminated, but what about the foods and drinks made from it?

Many of these products are specifically marketed to groups vulnerable to mercury. Soft drinks, fruit juices, and other junk food are successfully marketed to children not only through Internet and television advertising,[29] but also in school vending machine and cafeteria options.[30] People who rely on food stamps or who live in lower socioeconomic neighborhoods are also a special target for junk food manufacturers, because they offer the most accessible and often least expensive calories in the grocery store.[31]

Given the FDA's silence on the issue, we set out to do the nation's first public testing of national food brands that use HFCS for the presence of mercury.

We scouted supermarket shelves, looking both for manufactured foods and beverages marketed heavily to children as well as for products with HFCS as the first or second labeled ingredient. While manufacturers are not required to list the exact HFCS (or any other ingredient's) composition in food, they do need to list them in order of volume.

We tested products from some of America's leading food companies: Kraft, Hershey's, Hunt's, Smucker's, General Mills, Coca-Cola and so on. We sent their sodas, flavored milks, syrups, dressings and other products off to a commercial lab. The methodology and complete results are summarized in the Appendix.

Our laboratory analyzed for total mercury (not methylmercury). The samples we tested contained levels of total mercury ranging from below the limit of detection (LOD)—which ranged from 20-100 parts per trillion (ppt), depending on the nature of the sample and the processes the laboratory went through to adequately prepare it—to a high of 350 ppt.

Overall, we found detectable mercury in 17 of 55 samples, or around 31 percent. Quality control measures by the laboratory meant that some items in which initially there was no detectable mercury on re-analysis were found to have mercury above the LOD. If the latter would have been included our results, we would have found detectable mercury in a total of 20 of 55 samples, or 36 percent.

Table 2.	No. of Samples	No. with detectable mercury (above LOD)	Mercury detected
Beverages	19	3	15.8%
Dressings and condiments	10	4	40.0%
Dairy products*	5	3	60.0%
Snacks and desserts	8	3	37.5%
Soups and entrees	3	1	33.3%
Syrups and jellies	10	3	30.0%
Total	55	17	30.9%

* Two of three dairy products with detectable mercury were chocolate milk, which also could easily be categorized as beverages.

Mercury was most prevalent in HFCS-containing dairy product samples, followed by dressings and condiments and then snacks and desserts. The lowest prevalence of mercury detects was among the 19 beverages sampled. Two of the three dairy products with detectable mercury were chocolate milk. If these had been included instead in the beverage category, that latter category would have had a prevalence of detectable total mercury of 26 percent.

Table 3 indicates the food products for which total mercury was detected, highest to lowest.

Table 3.

Product Name	Total Mercury	Limit of Detection (ppt)
Quaker Oatmeal to Go	350	80
Jack Daniel's Barbecue Sauce (Heinz)	300	100
Hershey's Chocolate Syrup	257	50
Kraft Original Barbecue Sauce	200	100
Nutri-Grain Strawberry Cereal Bars	180	80
Manwich Bold Sloppy Joe	150	80
Market Pantry Grape Jelly	130	80
Smucker's Strawberry Jelly	100	80
Pop-Tarts Frosted Blueberry	100	80
Hunt's Tomato Ketchup	87	50
Wish-Bone Western Sweet & Smooth Dressing	72	50
Coca-Cola Classic	62	50
Yoplait Strawberry Yogurt	60	20
Minute Maid Berry Punch	40	30
Yoo-hoo Chocolate Drink	30	20
Nesquik Chocolate Milk	30	20
Kemps Fat Free Chocolate Milk	30	20

Of course, our survey was just a snapshot in time; we tested only one sample of each product. That is clearly not sufficient grounds to give definitive advice to consumers on specific products.

In other words, our efforts were never intended to take the place of full-scale safety testing by the FDA. But to us they do suggest a strong need for it, since Americans (and American children in particular) consume an awful lot of HFCS-containing products. It's a big chunk of their diet. That, plus the simple fact that adding mercury-containing HFCS to the food chain appears completely avoidable, makes this an issue worthy of much more attention.

Conclusion

Consumption of so many calories in sweeteners added to foods carries its own, well-recognized risks.

This report raises a separate, newly recognized problem when those calories come from HFCS. The long-term use of outdated mercury cell technology for making caustic soda—a key ingredient in HFCS production—has contaminated the food supply with an additional, preventable source of mercury.

In our own limited testing, we could detect mercury in about one of every three common foods or beverages where HFCS was the first or second labeled ingredient. Many of these foods are heavily marketed to children, who in turn are among those most vulnerable to mercury's toxic effects.

We know mercury is toxic in all its forms. We also know there are safer, readily available alternative ways to produce HFCS. And, despite the industry's reliance on mercury-grade ingredients, and the FDA's reluctance to make the public aware of this fact, we know there is a public health imperative to better protect our food and beverages from this unnecessary contaminant.

Recommendations for industry

Our simplest recommendation: *Stop using mercury cell technology. It is an outdated method. Mercury cells are not necessary to make caustic soda.*

Well over 100 chlor-alkali facilities worldwide have mothballed mercury cell technology since the 1970s. Though significant, most conversion costs can be recovered within five years.[32]

In the U.S., four plants remain uncommitted to phasing out mercury cell technology. Caustic soda from these and other mercury cell plants overseas could continue to be used to manufacture the HFCS destined for foods and beverages sold to Americans.

Another immediate solution: *Manufacturers of HFCS and other foods should simply discontinue using mercury-grade ingredients.*

In addition, concerned food manufacturers could use readily available, and perhaps safer, alternatives to HFCS—like table sugar. Coca-Cola's sodas sold in Mexico are made using sugar (their Mexican facilities never made the transition to HFCS). Companies selling in the U.S., such as Jones Soda Co., have started using cane sugar in place of HFCS in their drinks.

Moreover, as sales of organic food continue to rise in the United States and globally, the array of retail food products will contain a smaller percentage of HFCS. The organic beverage market grew from $23 million in 2002 to $40 million in 2006, and sales have grown by 17 percent to 20 percent per year over the past few years.[33] This may account for some of the recent decline in HFCS production and consumption. In addition, publicity around public health concerns with HFCS, as well as epidemics of diabetes and obesity, likely also play a role.

On the other hand, in economic terms HFCS and table sugar may no longer be considered "substitutes" for one another. That's because current technology in corn wet milling, as well as in food processing generally, has become highly specialized and specific to HFCS over the last few decades. The changes that would have to take place in logistics, infrastructure and technology for the soft drink industry to revert to using cane sugar instead of HFCS, for example, are significant and costly.[34]

Policy recommendations

1. **Phase out mercury cell technology.** Other countries, including Japan, have already banned the mercury cell chlor-alkali process. In 2007, then-Senator Barack Obama sponsored S. 1818, the "Missing Mercury in Manufacturing Monitoring and Mitigation Act."[35] If passed, the legislation would phase out the remaining mercury cells in use in the U.S. by January 2012.

2. **Ban the use of mercury-grade ingredients in food and beverages.** The FDA should ban mercury-grade caustic soda for food uses, given non-mercury alternatives. Pending that, any food containing HFCS ought to be labeled so as to identify whether the HFCS was manufactured using mercury-grade ingredients.

3. **In light of its mercury contamination, the FDA should revisit its on-again, off-again approval of HFCS as "natural" and "Generally Recognized As Safe" (GRAS).** According to a 1997 FDA statement, the proponent of an exemption from the definition of a food additive "has the burden of proving that the use of the substance is 'generally recognized' as safe." HFCS manufacturers should be required to have their products independently and publicly tested for mercury to assess potential human exposure levels.

Personal recommendations

For consumers, the simplest solution for now may be to avoid foods containing HFCS, particularly when it's high on the label.

Even if U.S. chlor-alkali plants discontinue using the mercury-based process, there are other plants worldwide that still do and they export to the United States. American consumers are still likely to eat food products containing HFCS that may be contaminated with mercury from these plants.

Beyond this fact, HFCS content, particularly high on the label, is a signal for a highly processed food high in added sweeteners (and therefore calories), and often high in added fats as well. Parents instead ought to be preferentially serving children whole, unprocessed foods.

Reduce other sources of mercury exposure to your kids, including dental amalgam and consumption of fish species known to contain mercury. Use IATP's Smart Fish Guide to learn more about safer fish consumption at: www.healthobservatory.org.

Appendix

In the fall of 2008, IATP purchased 55 branded food products, many of them marketed to children, with the purpose of testing them for contamination with mercury. The food products selected—sodas, other sweetened beverages, syrups, dressings, snack foods and others—were ones where HFCS was listed as the first or second labeled ingredient. While food manufacturers are not required to list the exact ingredient composition, they do need to list them in order of volume.

Food Product	Product Type
7-Up	Beverage
A & W Root Beer	Beverage
Aunt Jemima Original Syrup	Syrup
Campbell's Tomato Soup	Soup
Coca-Cola Classic	Beverage
Dr. Pepper	Beverage
Fanta Orange	Beverage
Hawaiian Punch Fruit Juicy Red	Beverage
Heinz Hotdog Relish	Condiment
Heinz Tomato Ketchup	Condiment
Hershey's Caramel Syrup	Syrup
Hershey's Chocolate Syrup	Syrup
Hershey's Strawberry Syrup	Syrup
Hi-C Wild Cherry	Beverage
Hunt's Tomato Ketchup	Condiment
Hy-Top Syrup	Syrup
Jack Daniel's Barbecue Sauce (Heinz)	Condiment
Jell-O Strawberry	Snack
Kemps Fat Free Chocolate Milk	Dairy
Kool-Aid Bursts Tropical Punch	Beverage
Kool-Aid Cherry Jammers	Beverage
Kraft Original Barbecue Sauce	Condiment
Land O' Lakes Chocolate Milk	Dairy
Lipton Green Tea	Beverage
Manwich Bold Sloppy Joe	Entrée
Market Pantry Applesauce	Snack
Market Pantry Cranberry Sauce	Condiment
Market Pantry Grape Jelly	Jelly
Market Pantry Ice Pops	Dessert
Market Pantry Thousand Island Dressing	Dressing
Market Pantry Tomato Soup	Soup
Minute Maid Berry Punch	Beverage
Mott's Applesauce	Snack
Mrs. Butterworth Original Syrup	Syrup
Nesquik Chocolate Milk	Dairy
Nesquik Strawberry Milk	Dairy
NOS High Performance Energy Drink	Beverage
Nutri-Grain Strawberry Cereal Bars	Snack
Ocean Spray Cranberry Sauce	Condiment
Pepsi	Beverage
Pop-Tarts Frosted Blueberry	Snack
Powerade Orange	Beverage
Quaker Oatmeal to Go	Snack
Smucker's Strawberry Jelly	Jelly
Smucker's Strawberry Syrup	Syrup
Snapple Peach Iced Tea	Beverage
Sunny-D	Beverage
Tropicana Twister Cherry Berry Blast	Beverage
Welch's Grape Jelly	Jelly
Wish-Bone Thousand Island Dressing	Dressing
Wish-Bone Western Sweet & Smooth Dressing	Dressing
Wyler's Italian Ices	Dessert
Yoo-hoo Chocolate Drink	Beverage
Yoplait Strawberry Yogurt	Dairy
Zoo Juice Orange	Beverage

We collected products from some of America's leading food companies: Kraft, Hershey's, Coca-Cola, and so on. We sent them off to a commercial food and chemistry laboratory, Bodycote Testing Group (www.Bodycotetesting.com) of Santa Fe Springs, California. The laboratory performs analyses for total mercury using atomic fluorescence (AF) spectroscopy.

In the Leeman Labs Hydra AF Gold Plus system, mercury is determined using the traditional cold vapor technique coupled with dual AF detectors. The system is compliant with EPA Methods 1631 and 245.7. Advantages to this method include extremely low detection limits in the part per trillion range, and a wide dynamic range (ppm to sub-ppt). The laboratory received the food and beverage samples with chain-of-custody intact. Preparation of the samples for analysis differed depending on the kind of food item. Subsamples were digested with weakly acidic solutions of aqua regia, or 4:1 $HCl/HNO3$), with some samples undergoing additional digestion using a solution of 30 percent hydrogen peroxide. Blanks were run using these same preparations so as to ensure that any mercury detections were not due to the reagents used.

After digestion, samples underwent total mercury analysis using Cold Vapor Atomic Fluorescence (CVAF). The detection limits varied for different laboratory "runs" of the food products, depending on the characteristics of the food item (e.g., carbonation, viscosity, etc.), and the preparation and dilution needed.

For each of the individual products tested, the following tables list the limit of detection calculated for that item, followed by total mercury (Hg) detected in that sample. ND refers to a non-detectable level, meaning that if there was mercury present, it could be below the limit of detection.

Beverages	Limit of detection (ppt)	Total Hg detected (ppt)
7-Up	30	ND
A & W Root Beer	30	ND
Coca-Cola Classic	50	62*
Dr. Pepper	30	ND
Fanta Orange	30	ND
Hawaiian Punch Fruit Juicy Red	50	ND
Hi-C Wild Cherry	30	ND
Kool-Aid Bursts Tropical Punch	30	ND
Kool-Aid Cherry Jammers	30	ND
Lipton Green Tea	30	ND
Minute Maid Berry Punch	30	40
NOS High Performance Energy Drink	50	ND
Pepsi	30	ND
Powerade Orange	30	ND
Snapple Peach Iced Tea	30	ND
Sunny-D	30	ND
Tropicana Twister Cherry Berry Blast	30	ND
Yoo-hoo Chocolate Drink	20	30
Zoo Juice Orange	30	ND
* Retesting of this result, for quality control purposes, revealed a ND result		

Dressings and condiments	Limit of detection (ppt)	Total Hg detected (ppt)
Heinz Hotdog Relish	100	ND
Heinz Tomato Ketchup	100	ND
Jack Daniel's Barbecue Sauce (Heinz)	100	300
Hunt's Tomato Ketchup	50	87
Kraft Original Barbecue Sauce	100	200
Market Pantry Cranberry Sauce	100	ND
Market Pantry Thousand Island Dressing	100	ND
Ocean Spray Cranberry Sauce	100	ND
Wish-Bone Thousand Island Dressing	100	ND
Wish-Bone Western Sweet & Smooth Dressing	50	72

Dairy	Limit of detection (ppt)	Total Hg detected (ppt)
Kemps Fat Free Chocolate Milk	20	30
Land O'Lakes Chocolate Milk	20	ND
Nesquik Chocolate Milk	20	30
Nesquik Strawberry Milk	20	ND
Yoplait Strawberry Yogurt	20	60

Snacks and Desserts	Limit of detection (ppt)	Total Hg detected (ppt)
Jell-O Strawberry	100	ND
Market Pantry Applesauce	100	ND
Market Pantry Ice Pops	30	ND
Mott's Applesauce	100	ND
Nutri-Grain Strawberry Cereal Bars	80	180
Pop-Tarts Frosted Blueberry	80	100
Quaker Oatmeal to Go	80	350
Wyler's Italian Ices	30	ND

Soups and Entreés	Limit of detection (ppt)	Total Hg detected (ppt)
Manwich Bold Sloppy Joe	80	150
Campbell's Tomato Soup	100	ND
Market Pantry Tomato Soup	100	ND

Syrup & jellies	Limit of detection (ppt)	Total Hg detected (ppt)
Aunt Jemima Original Syrup	100	ND*
Hershey's Caramel Syrup	100	ND
Hershey's Chocolate Syrup	50	257**
Hershey's Strawberry Syrup	100	ND
Hy-Top Syrup	50	ND
Market Pantry Grape Jelly	80	130
Mrs. Butterworth Original Syrup	100	ND
Smucker's Strawberry Jelly	80	100
Smucker's Strawberry Syrup	100	ND
Welch's Grape Jelly	100	ND

* Retesting of this result, for quality control purposes, yielded a result of 51 ppt
** Retesting of this result, for quality control purposes, yielded a result of 209 ppt

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