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REPORT

Metabolic Danger of High-Fructose Corn Syrup

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Americans are being poisoned by a common additive present in a wide array of processed foods like soft drinks and salad dressings, commercially made cakes and cookies, and breakfast cereals and brand-name breads.

This commonplace additive silently increases our risk of obesity, diabetes, hypertension, and atherosclerosis.

The name of this toxic additive is **high-fructose corn syrup**. It is so ubiquitous in processed foods and so over-consumed by the average American that many experts believe our nation faces the prospect of an epidemic of metabolic disease in the future, related in significant degree to excess consumption of **high-fructose corn syrup**.



The food industry has long known that “a spoonful of sugar helps the medicine go down in the most delightful way.” And cane sugar had been America’s most delightful sweetener of choice, that is, until the 1970s, when the much less expensive corn-derived sweeteners like maltodextrin and high-fructose corn syrup were developed. While regular table sugar (sucrose) is 50% fructose and 50% glucose, high-fructose corn syrup can contain up to 80% fructose and 20% glucose, almost twice the fructose of common table sugar. Both table sugar and high-fructose sweetener contain four calories per gram, so calories alone are not the key problem with high-fructose corn syrup. Rather, metabolism of excess amounts of fructose is the major concern.

The alarming rise in diseases^{1,2} related to poor lifestyle habits has been mirrored by an equally dramatic increase in fructose consumption, particularly in the form of the corn-derived sweetener, high-fructose corn syrup.³⁻¹² In this article, we’ll examine the evidence for these associations, and we’ll attempt to determine if **high-fructose corn syrup** is a benign food additive, as the sweetener industry has lobbied us (and the FDA) to believe, or a dangerously overlooked threat to public health.

RISING CONCERN

While cardiovascular disease remains the number one killer in America,¹ scientists have noted that “we are experiencing an epidemic of [heart and kidney] disease characterized by increasing rates of obesity, hypertension, the metabolic syndrome, type 2 diabetes, and kidney disease.”² Add to this list a disturbing rise in new cases of non-alcoholic fatty liver disease, and you have a public health crisis of enormous proportions.

With a growing sense of urgency, scientists are examining the relationship between consumption of high-fructose corn syrup (HFCS) and numerous adverse medical conditions. And they’re coming away with a sour taste in the mouth. Emerging research shows that excessive dietary fructose, largely from consumption of HFCS, represents “an important, but not well-appreciated dietary change,” which has “ .rapidly become an important causative factor in the development of the metabolic syndrome,”⁹ a conglomeration of risk factors that greatly elevates the risk of cardiovascular disease and diabetes. Other research suggests that high dietary fructose consumption contributes to obesity and insulin resistance,^{5,7} encourages kidney stone formation,¹³ promotes gout,¹⁴⁻¹⁷ and is contributing to an upsurge in cases of non-alcoholic fatty liver disease.^{4,18,19} Furthermore, high dietary fructose consumption is associated with increased production of advanced glycation end products (AGEs), which are linked with the complications of diabetes and with the aging process itself.^{2,5,7}

STEALTHY INSERTION INTO THE FOOD CHAIN

With little fanfare, and even less scrutiny, HFCS was introduced into the food supply decades ago. It is now commonly found in an astounding array of popular food and beverage products. Sweetened, carbonated soft drinks are considered by many to be the worst offenders.^{4,7} Food manufacturers embraced HFCS wholeheartedly because it is substantially cheaper than sucrose (table sugar) and mixes well with a variety of products, including beverages, baked goods, jams and jellies, candies, and dairy

products. In fact, between 1970 and 1990, the annual intake of HFCS increased by more than 1,000%, greatly exceeding the change in intake of any other food or food group. High-fructose corn syrup is now the primary caloric sweetener added to soft drinks in the United States, and comprises more than 40% of caloric sweeteners added to foods and beverages.^{20,21}

While it is derived from a natural source, HFCS is essentially an unnatural product, in the sense that for most of human history we consumed no more than about 15 grams of fructose per day (approximately one-half ounce), mostly from fruits and vegetables.

In contrast, daily consumption in 1997 was estimated to have increased to 81 grams (nearly three ounces) per day.⁷ For the first time in history, humans are consuming fructose at extraordinarily high levels.



THE DANGERS OF FRUCTOSE

High dietary intake of fructose is problematic because fructose is metabolized differently from glucose. Like fructose, glucose is a simple sugar. Derived from the breakdown of carbohydrates, glucose is a primary source of ready energy. Sucrose (table sugar) comprises one molecule of glucose and one molecule of fructose. Thus, excessive sucrose intake also contributes to the rise in overall daily fructose consumption. Glucose can be metabolized and converted to ATP, which is readily “burned” for energy by the cells’ mitochondria. Alternatively, glucose can be stored in the liver as a carbohydrate for later conversion to energy. Fructose, on the other hand, is more rapidly metabolized in the liver, flooding metabolic pathways and leading to increased triglyceride synthesis and fat storage in the liver. This can cause a rise in serum triglycerides, promoting an atherogenic lipid profile and elevating cardiovascular risk. Increased fat storage in the liver may lead to an increased incidence in non-alcoholic fatty liver disease, and this is one of several links between HFCS consumption and obesity as well as the metabolic syndrome.⁷

Fructose may have less impact on appetite than glucose, so processed foods rich in fructose can contribute to weight gain, obesity, and its related consequences by failing to manage appetite.²⁰ Additionally, loading of the liver with large amounts of fructose leads to increased uric acid formation, which may contribute to gout in susceptible individuals.⁷

WHAT YOU NEED TO KNOW: HEALTH-DAMAGING EFFECTS OF EXCESS DIETARY FRUCTOSE

- Dietary intake of fructose, particularly in the form of high-fructose corn syrup (HFCS), has dramatically increased in the US in recent decades. Increased HFCS consumption has paralleled increasing rates of obesity, metabolic syndrome, and other conditions associated with poor lifestyle habits.
- High-fructose corn syrup is found in sweetened carbonated soft drinks as well as in many packaged foods such as cakes, cookies, jams, jellies, and crackers.
- Excess fructose intake has been associated with adverse health effects such as metabolic syndrome, elevated triglyceride levels, hypertension, non-alcoholic fatty liver disease, excess uric acid levels (associated with gout), and elevated levels of advanced glycation end products (AGEs; linked with aging and complications of diabetes).
- Minimizing intake of dietary fructose is essential to mitigating its potentially dangerous effects. Sources of dietary fructose include HFCS, fruit juices, honey, and table sugar (sucrose; comprising fructose and glucose).
- Targeted nutritional strategies can help avert some of the damaging effects of excess fructose intake. Beneficial nutrients include benfotiamine, alpha-lipoic acid, carnosine, pyridoxamine, acetyl-L-carnitine, vitamin C, and fish oil.

FRUCTOSE LINKED WITH INSULIN RESISTANCE AND DIABETES

The high flux of fructose to the liver, the main organ capable of metabolizing this simple carbohydrate, disturbs glucose metabolism and uptake pathways and leads to metabolic disturbances that underlie the induction of insulin resistance,⁹ a hallmark of type 2 diabetes.