The Weston A. Price Foundation

The Double Danger of High Fructose Corn Syrup

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For many years, Dr. Meira Fields and her coworkers at the US Department of Agriculture investigated the harmful effects of dietary sugar on rats. They discovered that when male rats are fed a diet deficient in copper, with sucrose as the carbohydrate, they develop severe pathologies of vital organs. Liver, heart and testes exhibit extreme swelling, while the pancreas atrophies, invariably leading to death of the rats before maturity.

Sucrose is a disaccharide composed of 50 percent glucose and 50 percent fructose. Dr. Fields repeated her experiments to determine whether it was the glucose or fructose moiety that caused the harmful effects. Starch breaks down into glucose when digested. On a copper-deficient diet, the male rats showed some signs of copper deficiency, but not the gross abnormalities of vital organs that occur in rats on the sucrose diet. When the rats were fed fructose, the fatal organ abnormalities occured.

Lysl oxidase is a copper-dependent enzyme that participates in the formation of collagen and elastin. Fructose seems to interfere with copper metabolism to such an extent that collagen and elastin cannot form in growing animals–hence the hypertrophy of the heart and liver in young males. The females did not develop these abnormalities, but they resorbed their litters.[1]

These experiements should give us pause when we consider the great increase in the use of high fructose corn syrup during the past 30 years, particularly in soft drinks, fruit juices and other beverages aimed at growing children, children increasingly likely to be copper

deficient as modern parents no longer serve liver to their families. (Liver is by far the best source of copper in human diets.)

“The bodies of the children I see today are mush,” observed a concerned chiropractor

recently. The culprit is the modern diet, high in fructose and low in copper-containing foods, resulting in inadequate formation of elastin and collagen–the sinews that hold the body together.

BINGEING ON FRUCTOSE

Until the 1970s most of the sugar we ate came from sucrose derived from sugar beets or sugar cane. Then sugar from corn–corn syrup, fructose, dextrose, dextrine and especially high fructose corn syrup (HFCS)–began to gain popularity as a sweetener because it was much less expensive to produce. High fructose corn syrup can be manipulated to contain equal amounts of fructose and glucose, or up to 80 percent fructose and 20 percent glucose.[2] Thus, with almost twice the fructose, HFCS delivers a double danger compared to sugar.

(With regards to fruit, the ratio is usually 50 percent glucose and 50 percent fructose, but most commercial fruit juices have HFCS added. Fruit contains fiber which slows down the metabolism of fructose and other sugars, but the fructose in HFCS is absorbed very quickly.)

In 1980 the average person ate 39 pounds of fructose and 84 pounds of sucrose. In 1994 the average person ate 66 pounds of sucrose and 83 pounds of fructose, providing 19 percent of total caloric energy.[3] Today approximately 25 percent of our average caloric intake comes from sugars, with the larger fraction as fructose.[4]

High fructose corn syrup is extremely soluble and mixes well in many foods. It is cheap to produce, sweet and easy to store. It's used in everything from bread to pasta sauces to bacon to beer as well as in "health products" like protein bars and "natural" sodas.

FRUCTOSE FOR DIABETICS?

In the past, fructose was considered beneficial to diabetics because it is absorbed only 40 percent as quickly as glucose and causes only a modest rise in blood sugar.[5] However, research on other hormonal factors suggests that fructose actually promotes disease more readily than glucose. Glucose is metabolized in every cell in the body but all fructose must be metabolized in the liver.[6] The livers of test animals fed large amounts of fructose develop fatty deposits and cirrhosis, similar to problems that develop in the livers of alcoholics.

Pure fructose contains no enzymes, vitamins or minerals and robs the body of its micronutrient treasures in order to assimilate itself for physiological use.[7] While naturally occurring sugars, as well as sucrose, contain fructose bound to other sugars, high fructose corn syrup contains a good deal of "free" or unbound fructose. Research indicates that this free fructose interferes with the heart's use of key minerals like magnesium, copper and chromium. Among other consequences, HFCS has been implicated in elevated blood cholesterol levels and the creation of blood clots. It has been found to inhibit the action of white blood cells so that they are unable to defend the body against harmful foreign invaders.[8]

Studies on the Maillard reaction indicate that fructose may contribute to diabetic complications more readily than glucose. The Maillard reaction is a browning reaction that occurs when compounds are exposed to various sugars. Fructose browns food seven times faster than glucose, resulting in a decrease in protein quality and a toxicity of protein in the body.[9] This is due to the loss of amino acid residues and decreased protein digestibility. Maillard products can inhibit the uptake and metabolism of free amino acids and other nutrients such as zinc, and some advanced Maillard products have mutagenic and/or carcinogenic properties. The Maillard reactions between proteins and fructose, glucose, and other sugars may play a role in aging and in some clinical complications of diabetes.[10]

Fructose reduces the affinity of insulin for its receptor, which is the hallmark of type-2 diabetes. This is the first step for glucose to enter a cell and be metabolized. As a result, the body needs to pump out more insulin to handle the same amount of glucose.[21]

OTHER EFFECTS

Nancy Appleton, PhD, clinical nutritionist, has compiled a list of the harmful effects of fructose in her books *Lick the Sugar Habit, Healthy Bones, Heal Yourself With Natural Foods, The Curse Of Louis Pasteur and Lick the Sugar Habit Sugar Counter*. She points out that consumption of fructose causes a significant increase in the concentration of uric acid; after ingestion of glucose, no significant change occurs. An increase in uric acid can be an indicator of heart disease.[12] Furthermore, fructose ingestion in humans results in increases in blood lactic acid, especially in patients with preexisting acidotic conditions such as diabetes, postoperative stress or uremia. Extreme elevations cause metabolic acidosis and can result in death.[13]

Fructose is absorbed primarily in the jejunum before metabolism in the liver. Fructose is converted to fatty acids by the liver at a greater rate than is glucose.[14] When consumed in excess of dietary glucose, the liver cannot convert all of the excess fructose in the system and it may be malabsorbed. The portion that escapes conversion may be thrown out in the urine. Diarrhea can be a consequence.[19] A study of 25 patients with functional bowel disease showed that pronounced gastrointestinal distress may be provoked by malabsorption of small amounts of fructose.[26]

Fructose interacts with oral contraceptives and elevates insulin levels in women on "the pill."[17]

In studies with rats, fructose consistently produces higher kidney calcium concentrations than glucose. Fructose generally induces greater urinary concentrations of phosphorus and magnesium and lowered urinary pH compared with glucose.[18]

In humans, fructose feeding leads to mineral losses, especially higher fecal excretions of iron and magnesium, than did subjects fed sucrose. Iron, magnesium, calcium, and zinc balances tended to be more negative during the fructose-feeding period as compared to balances during the sucrose-feeding period.[19]

There is significant evidence that high sucrose diets may alter intracellular metabolism, which in turn facilitates accelerated aging through oxidative damage. Scientists found that the rats given fructose had more undesirable cross-linking changes in the collagen of their skin than in the other groups. These changes are also thought to be markers for aging. The scientists say that it is the fructose molecule in the sucrose, not the glucose, that plays the larger part.[20]

Because it is metabolized by the liver, fructose does not cause the pancreas to release insulin the way it normally does. Fructose converts to fat more than any other sugar. This may be one of the reasons Americans continue to get fatter. Fructose raises serum

triglycerides significantly. As a left-handed sugar, fructose digestion is very low. For complete internal conversion of fructose into glucose and acetates, it must rob ATP energy stores from the liver.[21]

Not only does fructose have more damaging effects in the presence of copper deficiency, fructose also inhibits copper metabolism–another example of the sweeteners double-whammy effect. A deficiency in copper leads to bone fragility, anemia, defects of the connective tissue, arteries, and bone, infertility, heart arrhythmias, high cholesterol levels, heart attacks, and an inability to control blood sugar levels.[22]

Although these studies were not designed to test the effects of fructose on weight gain, the observation of increased body weight associated with fructose ingestion is of interest. One explanation for this observation could be that fructose ingestion did not increase the production of two hormones, insulin and leptin, that have key roles in the long-term regulation of food intake and energy expenditure.[23]

HYPERSENSIVITY

The magnitude of the deleterious effects of fructose varies depending on such factors as age, sex, baseline glucose, insulin, triglyceride concentrations, the presence of insulin resistance, and the amount of dietary fructose consumed.[24] Some people are more sensitive to fructose. They include hypertensive, hyperinsulinemic, hypertriglyceridemic, non-insulin dependent diabetic people, people with functional bowel disease and postmenopausal women.[25]

Everyone should avoid over-exposure to fructose, but especially those listed above. One or two pieces of fruit per day is fine, but commercial fruit juices and any products containing high fructose corn syrup are more dangerous than sugar and should be removed from the diet.

Sidebar

SOFT DRINKS IN THE SCHOOLS

High fructose corn syrup is the primary sweetener used in soft drinks, now readily available to children in school vending machines. The soft drink industry increased US production from 22 to 41 gallons of soft drinks per person a year between 1970 and 1997.

Teenagers and children, the industry's main tragets, are among the largest consumers. In the past 10 years, soft drink consumption among children has almost doubled in the United States. Teenage boys now drink, on average, three or more cans of soda per day, and 10 percent drink seven or more cans a day. The average for teenage girls is more than two cans a day, and 10 percent drink more than five cans a day. A typical 20-ounce Coke contains zero fat, zero protein and 67 grams of carbohydrates, usually in the form of high fructose corn syrup.

There are an estimated 20,000 vending machines in schools nationwide, according to the National Automatic Merchandising Association. The USDA collected data on vending machines in schools and reported that 88 percent of high schools, 61 percent of middle schools and 14 percent of elementary schools have food or beverage vending machines for student use. Thirty-four percent of high schools and 15 percent of middle schools permit students to use school vending machines at any time, and 6 percent of elementary schools allow students to use vending machines during lunch.

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