

## HIGH FRUCTOSE CORN SYRUP: HISTORY, SPREAD, and CONSUMPTION

### **ABSTRACT**

Sweet syrups have been used for centuries as a substitute for sucrose. High fructose corn syrup (HFCS) was popularized in the 1970s and has since become an overwhelmingly popular ingredient in American food products due to its cheapness, ease of production, and widespread availability. This in turn has led the average American person to ingest large amounts of HFCS, which some studies show to be a growing factor in rising obesity, liver disease, and diabetes rates.

What do Coca-Cola, Wheat Thins and Heinz Ketchup all have in common? Apart from all being food, each product contains a sizeable amount of high fructose corn syrup (HFCS). In fact, there are so many products currently containing HFCS that last year, the average American ingested 200 calories a day from HFCS (Helm). Indeed, the digestion of large amounts of HFCS has become such a routine part of our lives that many people overlook, or are unaware of, their consumption of it. Since its invention and refinement in the 1970s, HFCS has become a remarkably prevalent key component of processed foods in the USA. Despite its current role as a leading preservative and effective sugar substitute, the sheer quantity of HFCS present on our supermarket shelves presents the public with many potential dangers that many of them have yet to realise.

Although HFCS didn't become a standard American sweetener until the 1970s, the concept of deriving sweet syrups from starches dates back to the Napoleonic Wars. In 1811, a German chemist named Gottlieb Kirchoff derived a sweet syrup from potato starch in order to counter the lack of cane sugar caused by the British Naval Blockade. However, his discovery was quickly found to be an economic goldmine, and soon, scientists throughout Europe (and later, the rest of the world) raced to create syrups that would both taste as sweet as sucrose (aka table sugar) and crystallize easily (Dziedzic 2). Nevertheless, it was not until the late 20<sup>th</sup> century

that a syrup was created that fulfilled both goals. Previously neglected because of low yields and bad coloring, HFCS became an industrial reality in the 1960s, when a xylose isomerase enzyme was successfully used to convert glucose into fructose at levels of 42% fructose and higher (Landis 86). That breakthrough, in conjunction with the fact that corn is both planted on nearly 80 million acres (Baker) and is subsidized in the USA (Hopkins), led to a huge gain in HFCS's popularity because HFCS soon became cheaper than actual sugar. In fact, the "use of HFCS grew rapidly, from less than three million short tons in 1980 to almost 8 million short tons in 1995" (Forristal). Furthermore, "during the late 1990s, [the] use of sugar actually declined as it was eclipsed by HFCS... [And] today Americans consume more HFCS than sugar" (Forristal).

One reason for HFCS's popularity is the simplicity of the process by which it is created. First, corn kernels are shelled and soaked in a solution of water and sulphur dioxide in order to soften them. Then, the softened kernels are sent to a degerminating mill, where the lighter weight germ is separated from the remainder of the kernel and used to make corn oil. The rest of the kernel, however, is mixed with water and passed through a series of screens and hydroclones to further extract and purify the corn starch. Then, the pure corn starch is treated with enzymes that convert glucose to fructose. Lastly, the fructose syrup is purified one last time, yielding true HFCS (Landis 90). The HFCS can then be transported out to food factories in trucks and pumped into holding tanks, requiring "only simple dilution before use" (White). Thus, due to the ease with which HFCS is produced, transported, and utilized, it has become a staple sweetener and a preservative in all manner of products, ranging from Ritz crackers to, most visibly, beverages.

Due to HFCS's sweetness, cheapness, and availability, it has become the choice sweetener for most soft drinks and fruit juices. In 2008, *The Chicago Tribune* ran an article advising readers to avoid fruit juices in order to cut down on HFCS intake, as many "... fruit

"drinks," "punches," "cocktails" or "-ades," are simply code names for added sugar -- primarily high fructose corn syrup" (Helm). Sodas, however, are probably the leading container of large amounts of HFCS. According to the same *Tribune* article as above, "a single 12-ounce can [of soda] contains about 13 teaspoons of sugar in the form of high fructose corn syrup" (Helm). This is both unhealthy and potentially dangerous, seeing as the "federal dietary guidelines recommend that we limit added sugars to about 8 teaspoons (32 grams) a day for an average 2,000-calorie diet" (Helm). In addition, many people do not realise that they are getting HFCS from many different, and sometimes surprising places. Though some may try to avoid HFCS by opting for "natural" or "genetically modified organism (GMO) free" foods, the Corn Refiner's Association states that HFCS "meets the Food and Drug Administration's requirements for use of the term "natural"" and does not contain "measurable amounts of DNA" from the GMO corn it is produced from (HFCS Myths). Therefore, HFCS can be marketed as a "natural" -- something that many people are not aware of. Also, because of HFCS's versatility as a preservative, the syrup can be found in a myriad of products, ranging from spaghetti sauce to yoghurt to canned and frozen fruit (HFCS Myths). Thus, the average American usually ends up ingesting HFCS from a variety of sources, and therefore, in much larger amounts than the FDA recommends.

As a result of this overwhelming consumption (the only time since the 1970s when HFCS consumption did not rise was during a brief period between 2000 and 2004), some experts believe that HFCS intake directly correlates to rising rates of American obesity and diabetes. A study done on rats that were given high levels of fructose, instead of glucose, resulted in "...anemia, high cholesterol, and heart hypertrophy" (Forristal). Additionally, studies conducted by researcher John White revealed that "... fructose is rapidly taken up by the liver and bypasses a key regulatory step in glycolysis," which, unlike glucose, which is absorbed directly into the

bloodstream (White). Some scientists believe that this key difference between fructose and glucose may be suppressing the body's sense of fullness, thus allowing people to eat more than they would usually (Helm). This in turn would eventually cause the liver to get clogged up and contract various liver diseases and diabetes. In a Saint Louis University study done on the topic, mice were given food similar to the everyday American diet, complete with high amounts of HFCS. Unlike other studies, the mice weren't forced to eat – they were allowed to eat whenever they wanted. The results were astounding. One doctor involved noted, "we had a feeling we'd see evidence of fatty liver disease by the end of the study, but we were surprised to find how severe the damage was and how quickly it occurred. It took only four weeks for liver enzymes to increase and for glucose intolerance - the beginning of type II diabetes - to begin" (Dixon).

However, despite such results, most experts agree that as yet, HFCS cannot be identified as the *sole* culprit for rising global obesity and diabetes rates. As the Corn Refiner's Association points out, American lifestyle habits involve less active exercise now, and even though global obesity rates are rising, the use of HFCS outside the USA is limited (HFCS Myths). The above Saint Louis University research team also echoes that, adding that the take-home message for humans is obvious – “a high-fat and sugar-sweetened water diet compounded by a sedentary lifestyle will have severe repercussions for your liver and other vital organs” (Dixon). Thus, the current consensus seems to be that HFCS is likely a contributor to rising obesity rates, but not its only cause (Duffey).

Although many glucose syrups have been used as to replace sucrose since the 19<sup>th</sup> century, none has ever reached the same levels of production and consumption as HFCS. As a result, we are seeing for the first time a direct link between HFCS and rising levels of obesity, liver disease, and diabetes. Though it isn't the only cause of such conditions, people should take

caution. Small quantities of HFCS add up to dangerous amounts, and with HFCS present in everything ranging from spaghetti sauce to soda, people truly need to exercise greater caution regarding what they eat. Even though we're unlikely to ever ban HFCS from our diets, we can at least limit our intake and begin a shift towards healthier diets.

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