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Agave Syrup-What it is and what it is not. (Fructose, Agave Syrup and Health)

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Recent controversy about the role of High Fructose Corn Syrup (HFCS) and the role of fructose in promoting obesity has expanded to include comments critical of agave syrup. While the increase in obesity and related diseases over the past couple of decades is not in dispute, the causes are hotly debated, with evidence that ranges from sound science to complete conjecture. As a supplier of agave syrup, honey and other organic and non-GMO sweeteners (tapioca glucose syrups), CIRANDA has firsthand experience with the growing and processing of our ingredients.

Following is an explanation of the different sweeteners in question (sucrose, fructose and glucose); the current state of scientific knowledge on how these sweeteners affect the human body and metabolism; how our agave and tapioca sweeteners are produced; how their source material and processing differ from the production of corn syrups; and what this means to your customers who are reading the label and asking you questions.

Sugars

Before going into the pluses and minuses of fructose and glucose contained in agave and HFCS, we need to know more about sugars, specifically sucrose (commonly known as cane or beet sugar), glucose and fructose.

Sucrose is generally referred to as just "sugar", and it is the sweetener that consumers are most familiar with. Sucrose consists of one glucose molecule and one fructose molecule linked together. Sucrose can be found in various fruits and vegetables, but is mainly derived from sugar cane or sugar beets. When a person consumes sucrose the digestive system breaks the bond between the fructose and glucose and metabolizes them as free fructose and free glucose.

Glucose is derived from starch. Starch consists of long chains of glucose molecules linked together. Breaking these chains leads to free glucose. When a person eats a starch source such as corn, potatoes, wheat, or most grains, the enzymes produced by the body very efficiently break the starch down into glucose. This is why a piece of bread has a high glycemic index: all the starch in the bread is broken down into glucose and is metabolized, raising the blood glucose level.

Fructose, sometimes known as fruit sugar, exists naturally in fruits and honey as a single unit of fructose. It exists naturally in inulin as a long chain of fructose molecules linked together, similar to the glucose chains in starch. Inulin is found in carrots, garlic, agave, chicory, Jerusalem artichoke and

many other common foods. The bonds in inulin can be broken to make free fructose. When a person eats a food containing inulin, the body's enzymes do *not* break down the inulin. Instead, the inulin is consumed by bacteria in the intestine. The bacteria that consume the inulin tend to be the beneficial bacteria, the same types found in yogurts and various probiotic foods. Because the inulin feeds these beneficial organisms, allowing them to outcompete the detrimental intestinal organisms, inulin is labeled a prebiotic and has many health benefits that are well documented. While fructose can be made by hydrolyzing or breaking the bonds of inulin, it can also be made by using an isomerase enzyme to change glucose into fructose, a commercial process that became economical in the early 1970's.

In ancient times the main carbohydrates were glucose based starches and fructose based inulins. Free fructose and glucose were very common in the form of honey and fruit. It wasn't until the discovery of how to refine sugar cane in about 350AD that sucrose started becoming a common part of the diet.

The effects of sugars on the body

Glucose is processed in the muscles and fat throughout the body with the use of insulin. Insulin is used by the body to control metabolism and tells the muscles to burn either fat or glucose. Fructose is processed almost exclusively in the liver and does not need insulin to be turned into energy. Both sugars consumed in excess of the energy needs of the body are stored as fat.

Sucrose, consisting of 50% glucose and 50% fructose, is metabolized as though it were ingested as discrete fructose and glucose[1].

Most of the studies noting harmful effects of fructose were performed due to concern about the increasing obesity rate in the US. It was postulated based on a time correlation that the obesity rate and the related health problems might be due to the increased use of HFCS[2]. Trying to determine the linkage, many studies fed laboratory animals and people excessive amounts of fructose to check the effects. Almost all of the studies had the subjects consume *very* high quantities of sucrose or fructose, ranging from 50% to 15% of total calories as fructose[3]. In terms of the average caloric intake per person for 2007 in the US, this is the amount of fructose received by drinking 5 to 17 cans of soda per day [4].

While there are people that consume this much fructose, it is definitely at the far end of the spectrum. It is calculated that the average intake of fructose in 2007 in the US is under 60 grams per day (3 cans of soda), or about 9% of total calories. The average ratio of fructose to glucose consumed has not changed much since 1970, moving from 1:1.3 to 1:1.2[4]. The biggest change since 1970 to 2007 is that in the US we are eating much more. Overall, we are eating almost 28% more calories per day in *all* categories of foods. Only part of this increase is sugars[4].

Many of the articles that attack agave and HFCS cite various studies as support; however on careful examination we find that many of the authors of these studies call the results inconclusive[5, 6] or state that the data on humans is "less clear"[7]. The only clear correlation is that *very* high amounts of fructose can be detrimental.

There is some health benefit to fructose as a sweetener. One study showed that fructose helps decrease the risk of prostate cancer. The same study shows that fructose may help metabolize vitamin D from fortified milk[8]. These results were from moderate consumption of fructose with no difference found between fruit based fructose and HFCS based fructose. Yet, there are a large number of studies showing that overconsumption of sugars is not healthy. This is true for glucose, fructose and sucrose. The detrimental health effects can become much worse with a high saturated fat diet[9]. This is of major concern since the intake of fat in the diet has increased by 55% from 1970 to 2007[4].

There are no known detrimental health effects of *moderate* consumption of fructose in an average diet. *Overconsumption* of fructose from sucrose, corn syrup or other sources can have detrimental impacts on health, especially with high fat diets. Overconsumption would start at roughly one and one half times the current average consumption.

Syrups

Syrups (liquid sweeteners) are not only used for sweetening. They have a wide range of other functions such as binding various ingredients in granola, cookies and bars; controlling crystallization in ice cream and candy; extending shelf life by controlling staling; creating browning and caramel flavors; and many more useful functions. Many of the foods we eat would not be possible without the use of syrups.

Different syrups have different properties related to the types of carbohydrates in the syrups. The carbohydrates are determined by the source material: starch, inulin or sucrose, and the type of processing used for manufacturing.

Corn syrup

There are many types of corn syrups with various carbohydrate profiles. All are derived from the starch of the corn kernel. The glucose chains in the starch can be broken to create pure glucose or various chain lengths of glucose molecules. The longer chains tend to be much less sweet than glucose, but can provide viscosity and various other functional aspects.

To make corn syrup, dried corn is ground with water and sulfur dioxide. The kernel, fiber and protein are then separated from the starch mix to yield a starch slurry. This starch slurry is then typically processed with both high temperature and acid to convert the starch to shorter chain glucose molecules.

To produce HFCS, the acid is neutralized and the syrup is treated with an enzyme that converts the remaining glucose chains to free glucose. Part of the glucose in this syrup is then converted to fructose using an isomerase enzyme. This makes a dilute 42% fructose and 55% glucose syrup. The dilute syrup is processed to separate the fructose from the glucose. The concentrated fructose can then be taken to make syrup with up to 90% fructose. To make the 55% fructose/45% glucose syrup most commonly used, some of the 90% fructose syrup is added back to the 42% fructose base. Almost all of the HFCS sold in the U.S. is the 55% fructose, 45% glucose syrup.

During corn syrup processing, there are typically strong acids and caustics used. It was these chemicals that were believed to have been the source of some recently discovered mercury contamination of HFCS. In addition, since most of the corn in the U.S. is genetically modified, most of the corn syrup is manufactured from GMO corn.

Tapioca syrup processing

Tapioca syrup has some initial similarities to corn syrup processing; both are based on starch. To make tapioca starch, the root of the tapioca plant is ground with water to release the starch; no sulfur dioxide is used. The starch is washed, the fiber removed, and the starch dried. To make the tapioca syrup, water and natural non-GMO enzymes are added to the dry starch to make a slurry. This solution is heated and the enzymes begin breaking the glucose chains. During this process, no acids or caustics are used. Using a variety of enzymes, various syrups can be manufactured. A tapioca syrup containing 42% fructose is manufactured using a natural non-GMO isomerase enzyme.

The major differences between tapioca syrup and corn syrup are the lack of chemicals and the non-GMO source material used to make the tapioca syrup. While most of the corn syrup sold in the U.S. is HFCS, most of the tapioca syrup sold does not contain fructose.

Agave processing

There are two distinct types of agave syrup: one made from the sap of the agave, and one made from the main body (piña) of the agave plant. Both types are fructose syrups but manufactured in different ways.

Agave sap processing

The stalk sent up by the agave plant for reproduction is cut down and a hollow formed where it grew. This hollow fills with the sap sent by the plant to nourish the stalk growth. The sap is partially hydrolyzed agave inulin (some of the inulin fructose chains have been broken), naturally containing some free fructose. The sap is collected, filtered, and processed with a natural, non-GMO enzyme that finishes breaking the remaining inulin into its components, fructose and glucose. The dilute sugars solution is concentrated by removing the water. The result is agave syrup of approximately 70% fructose and 25% glucose.

Agave piña or body processing

The spreading leaves are chopped from the agave piña and the piña is transported to the processing plant. The piña is ground up with hot water, releasing the inulin from the insoluble fiber. The insoluble fiber is filtered out leaving dilute inulin syrup. The syrup is processed with either high heat (primarily used in the tequila industry), low heat and extended time, or low heat and enzymes. All processes break down the inulin into fructose and glucose. The dilute fructose syrup is then concentrated, yielding a syrup of approximately 80% fructose and 17% glucose.

Neither type of agave syrup uses the isomerase enzyme to change glucose into fructose. The agave plant has been used as a fructose source for hundreds, if not thousands, of years. Ancient agave

roasting pits can be found in the U.S. Southwest and Central America. Some villages in Mexico still roast agave which yields a sweet fructose containing food.

Summary

Agave syrup *is* fructose syrup. It contains a higher level of fructose than HFCS. Fructose is one of the main sugars in the world, since fructose is half of table sugar. In an average diet there are no health problems associated with fructose except for some individuals who may be fructose intolerant. Fructose was given GRAS status in 1983 and was reconfirmed in 1996 after a study of the available clinical trials on the effects of fructose consumption. Fructose has a low glycemic index and can be used to help control blood glucose levels in concert with a total diet plan. No sugar should be used excessively on a habitual basis; using fructose excessively does appear to be worse than using glucose to excess.

Agave syrup is not processed in the same manner as corn syrup. Agave naturally contains inulin, a long chain fructose molecule. Corn syrup is made from starch, a long chain glucose molecule that is changed from glucose into fructose by the use of a specific enzyme. You could not make HFCS In your kitchen at home but you could easily make agave syrup with utensils and ingredients normally available.

The current obesity and health problems are not due to the types of sugars or the source of the sugars but rather with our desire to eat too much sugar and fat. Besides sweetening foods, syrups perform many other functions. Without the use of syrups, many of our foods would not be as high in quality as they currently are. While it is wise to know what type of nutrients you are eating, it is imperative that the amount of those nutrients also be controlled.

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