Sweet Cravings, on Natural & Processed Sweeteners

Part 2: Corn Syrups, Agave Nectar & *Aguamiel*

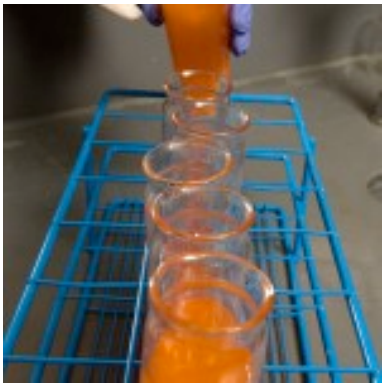
by Catherine Haug

There are so many sweeteners on the market, and so much information about the benefits and potential harm of each, that it is really bewildering. Of course, when we are really being honest, we know that we should be minimizing our consumption of all sweeteners. But it's so hard to do when 'sweet' tastes so good.

So, what is one to believe? Which is the best choice for your own health and that of your children, when it comes to sweeteners?

See also:

Part 1: Natural Sugar Sweeteners; **Part 3**: Natural Stevia & Artificial Sweeteners



Corn Syrups

(photo of High Fructose Corn Syrup from Princeton Univ.)

While High Fructose Corn Syrup (HFCS) is made from corn (like regular corn syrup), it is not a natural sweetener because it is industrially modified to increase its sweetness. This involves converting some of the sugar from glucose to L-fructose. And it's this fructose that is at the heart of the debate about the healthfulness (or lack thereof) of this sweetener so ubiquitous in processed foods and soda drinks. Fructose, especially L-fructose, is believed to fuel the rise in obesity, diabetes and liver problems, which are reaching epidemic proportions.

The news on HFCS is not good, despite what the Corn Refiners Association is saying: (2)

> *" There's a lot of misinformation out there about sugars made from corn. Truth is, high fructose cory syrup is nutritionally the same as table sugar. The same number of calories too. ... and is handled similarly by the body.*
>
> *HFCS provides many consumer benefits and often plays a key role in the integrity of food and beverage products that has little to do with sweetening."*

Just what is HFCS?

To make regular corn syrup, corn's starches are hydrolyzed (broken down) with amylase enzymes, to produce a syrupy solution of D-glucose. But glucose is not very sweet; fructose is far sweeter. And the sweetness of sucrose (half glucose, half fructose) is 'just right,' as Goldilocks would say.

So special enzymes were genetically engineered to convert the glucose of corn syrup to fructose. Unfortunately, is is L-fructose that is produced.

Then it is mixed roughly 50-50 with plain corn syrup to make a 50-50 mix of D-glucose & L-fructose that approximates the just-right sweetness of sucrose.

But even though HFCS has the same 50% glucose, 50% fructose content as table sugar, they are metabolized differently. They are not, as the industry would like us to believe, "handled similarly by the body."

Metabolism of HFCS vs Table Sugar

When these sweeteners are absorbed after digestion, they are metabolized differently in the body because table sugar has D-fructose and HFCS has L-fructose; the body does not recognize L-fructose from HFCS, and treats it like a toxin.

- D-fructose* (from sucrose) is carried by the blood to the liver where it can be burned for energy, or, more likely, converted to storage forms (glycogen or triglycerides).
- L-fructose* (from HFCS) is not bio-active (is not recognized by the body as nourishment), and cannot be used for energy production. Instead, it is absorbed and detoxed by conversion to triglycerides (fat) in the liver). (3)

(* See Basic Bio-chemistry of Glucose, Fructose and Sucrose for more detail)

This can explain, at least in part, how HFCS consumption can lead to obesity: (4)

> *"A [2008] study, published in the journal of Clinical Endocrinology and Metabolism, found that obese people who drank a fructose-sweetened beverage with a meal had triglyceride levels [in the blood] almost 200% higher than obese people who drank a glucose-sweetened beverage with a meal." (4)*

And remember that chronic high triglycerides in the blood translate into increased insulin resistance, inflammation and heart disease, as well as obesity. (4)

Other problems associated with fructose consumption include:

- Malabsorption problems in the gut, resulting in gas, bloating and other digestive distress;
- Liver disease, similar to that caused by excess consumption of alcohol.

Bottom line on HFCS

From a sustainability viewpoint, HFCS is not good because it is a highly processed sweetener, using genetically engineered enzymes, consuming a lot of energy to produce, and resulting in environmental pollution. Regular corn syrup is not much better.

The problem of excessive fructose intake on overall health, and health of the liver in particular, put this very low on my list of acceptable sweeteners. So low, in fact, that it has slipped off my list altogether.

Agave Nectar & *Aguamiel*

(photo of Agave Nectar and Tea from The Kitchn.com)

The current darling among alternative sweeteners is agave nectar, touted as 'natural' and safe for diabetics. Some brands are labeled as 'Organic,' a practice that is much disputed as false, because of the high level of processing used to produce it.

Promoters of agave nectar say that it comes from the sap of the agave plant; the same sap used by traditional peoples to make tequila. But this is an extreme stretch of the truth! Commercial agave nectar is not made from collected sap, but rather from the shredded root of this inulin-rich agave plant.

Agave Sap vs. Agave 'Nectar'

This sap comes from the *piña*, the pineapple-like root stalk of the plant from which the leaves grow. During winter and spring, the plant becomes full of the sap to provide feed for the flower and developing seed. It is at this time that the *piña* is at its sweetest (7).

The sweet sap or *aguamiel* can be collected from the *piña* for use as a sweetener and medicinal purposes, as well as to make *pulque* (the national drink of Mexico), or to make fermented tequila. This sap is rich in D-fructose resulting from a natural process used by the plant to break down the inulin fiber into shorter poly-fructose molecules. (1)

However, most makers of agave nectar do not collect the sap. Instead, they collect and shred the whole *piña*, then treat it with enzymes (differing by producer), to break down the inulin and starches into simple sugars:

- enzymes from *Aspergillis niger* mold via a patented process to break down the starch into D-glucose and inulin into D-fructose (8). This method produces a mix of glucose and fructose similar to that of sucrose.
- genetically engineered enzymes (the same as those used in making HFCS) to convert glucose from the agave starches into L-fructose. This method produces a D- and L-fructose mix that can be as high as 92%! (4, 8)

Then the sugary mixture is further refined before bottling for sale as agave nectar.

What is Inulin?

Some plants (corn, for example) store energy in the form of digestible starches, which are chains of D-glucose; others (agave, for example) store energy in the form of inulins, which are chains of D-fructose. (9)

Because we lack the enzymes necessary to break the fructose bonds of inulin, we call it fiber. While we cannot digest inulin, the probiotics in our gut digest it for us, producing not fructose, but short-chain fatty acids essential for liver function. In the case of agave, the plant produces its own enzymes to break down the inulin into shorter fructose chains and free D-fructose to feed the developing seed.

Organic Agave Syrup & *Aguamiel*

As mentioned earlier, traditional peoples in Mexico use the sap of the agave plant as a sweetener, to make tequila, and for medicinal purposes. This sap, known as *aguamiel* ("honey water"), is extracted from the live *piña* and is minimally processed, even less so than maple syrup, because it is not boiled (7; also describes how the sap is collected).

Organic *aguamiel* is currently sold as agave syrup by some ethical companies. However, not all 'organic' agave nectars are made from *aguamiel*. Many are made from shredded root, then refined and chemically modified as described above, and may not be organic at all.

Dr. Mercola writes in his Huffington Post article (6):

> *"Nevertheless, these ethical companies seek to provide an outstanding product. There are few companies who commit to and actually achieve these criteria and actually:*
>
> - *Work with the indigenous people;*
> - *Use organic agave as the raw material, free of pesticides;*
> - *Process it at low temperatures to preserve all the natural enzymes;*
> - *Produce a final agave product that is closer to 50% fructose instead of over 90%'*
> - *[Contain] fructose [that] is bonded or conjugated to other sugars and not floating around as "free" fructose, like HFCS, which is far more damaging.*
>
> *The VAST majority of companies however do not apply these principles and essentially produce a product that is, as this article states, FAR worse than HFCS [because of the exceptionally high fructose content over 90%]."*

The problem is that it is next to impossible to distinguish between the ethical companies, and those that simply slap the 'organic' label on their products to increase sales, when there is nothing organic about it. Impossible, that is, unless you can actually visit the processing site and see for yourself, and how many of us can afford to do that?

Bottom line on agave nectar

The important thing to carry away from this discussion is that commercial agave nectar does not contain the original starch and inulin from the natural agave, but rather highly processed simple sugars: fructose and glucose. Thus it does not provide any of the health benefit of inulin or *aguamiel*, and may come with all the health problems of HFCS.

And because it contains such high levels of fructose, it is highly likely it will cause problems for the liver in its frantic effort to convert the fructose to tri-glycerides, ultimately leading to obesity, fatty liver, heart disease, and potentially to diabetes.

From a sustainability viewpoint, commercial agave nectar is not good because it is industrially produced, requiring large amounts of energy and producing environmental pollution.

For this reason, I do not use agave nectar in any of my recipes. However, I would use true *aguamiel* if I could find it.

Basic Bio-chemistry of Glucose, Fructose and Sucrose

These three sugars are common in many of the foods we eat:

- **Glucose** (dextrose) - the main simple sugar carried in the blood and used to create energy for body functions. It is a 6-carbon sugar with molecular formula $C_6H_{12}O_6$, forming a 6-member ring, and comes in two mirror image forms: D-glucose, the only form present in nature, and synthetic L-glucose, which is not bio-active, and is detoxed in the liver by conversion to fat (triglycerides).

  D-glucose travels via the blood to all cells of the body where it invokes the insulin response, to initiate uptake of the glucose by those cells needing the energy. Or it can be converted in muscle cells to glycogen for short-term storage. It can also be carried to the liver for conversion to glycogen or triglycerides (fat) for storage.

  D-Glucose is also critical in protein and lipid (fat) production and metabolism, and in most animals also for formation of vitamin-C. (1)

- **Fructose** (levulose) - the simple sugar found in fruits. It is also a 6-carbon sugar with molecular formula $C_6H_{12}O_6$, and forms two different rings: a 6-member ring in the crystalline form, and a 5-member ring in solution and food. It comes in two mirror image forms: D-fructose, the only form present in nature, and synthetic L-fructose, which is not bio-active and is detoxed in the liver by conversion to triglycerides (fat).

  D-Fructose does not invoke the insulin response and can only be metabolized in the liver, where it is most likely to get converted to fat (triglycerides) or glycogen for storage, or burned for energy. (1)

- **Sucrose** - the disaccharide found in sugarcane & sugar beets (and to a lesser extent in maple syrup and honey). It is a 12-carbon sugar with molecular formula $C_{12}H_{22}O_{11}$, formed with one 6-member D-glucose ring and one 5-member D-fructose ring linked together to form a new substance chemically different from its two constituent sugars.

  It is not absorbed directly into the blood; it must first be hydrolyzed into its constituent sugars which are then absorbed. Because one of these is glucose, it does invoke the insulin response.

Of these three, fructose is the sweetest, followed by sucrose and then glucose. In numerical terms, fructose is about 173%, and glucose about 74.3% as sweet as sucrose (1).

Sources & References:

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