SUGAR: How Bad Can It Be?

By Noah Volz

Author of New Year Re-Solution

The Cranky Context Behind Inflammation, Mood Disorders and the World’s Sweet Tooth
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I am hopeful that this article you will inspire permanent change in your relationship with sugar. We will explore how sugar affects the body and what we can do about it. In order to make lasting change we need to understand what is happening when we eat sugar, the psychology created by brain chemicals secreted when we eat sugar and what practices we can use to let sugar go. Ayurveda is a form of personalized medicine that focuses on bio-individuality—the science of what our body does with what we eat. Each one of us will have a different threshold for sugar, but there are some actions that everyone can take.

So what is the big deal?
Intuitively we all know that sugar is bad for us, but how bad is it?

- The opposite of a nutrient, refined sugar is an antinutrient. It has no known benefits and can adversely affect our epigenetics (gene expression)
- Sugar has a powerful effect on our mood, self esteem and mental function and it's affects has been compared to those of heroine

So now that we have set the stage, let's look at the physiology underlying sugar metabolism.

What is sugar and how is it measured?

Understanding the building blocks of sweetness

There are three types of sugar:

1. Monosaccharides
2. Disaccharides
3. Polysaccharides

Each type is more complex than the previous. Monosaccharides are simple sugar molecules with only one (mono) saccharide (starch). There are three types of monosaccharides.

1. **Glucose** is required by all cells to create ATP—energy at the cellular level. It is especially prevalent in the brain and red blood cells and it can be absorbed directly into the blood stream from the gastro-intestinal tract
2. **Galactose** is converted into glucose in the liver
3. **Fructose** is absorbed and utilized by the liver

Disaccharides are composed of two monosaccharides bonded together. There are three types of disaccharides.
• **Sucrose** = glucose and fructose. Sucrose is often referred to as table sugar as it is the refined white sugar that comes primarily from sugar cane and sugar beets.
• **Lactose** = galactose and glucose. Lactose is the primary sugar found in milk.
• **Maltose** = glucose and glucose. Maltose is created when starches are broken down like when making beer.

Polysaccharides are the most complex of all the sugars and may include any of the preceding sugar molecules in addition to fiber, vitamins, minerals and other naturally occurring chemicals. These are often referred to as plant sugars, which include most grains and vegetables.

Together, these three sugar types make up the classification of foods known to dieticians as **carbohydrates**. In terms of carbohydrates, monosaccharides and disaccharides are simple carbs and polysaccharides are complex carbohydrates. As you can imagine each one of these will break down at a different speed within the body.

**Sugars Effect on the Body**

Now let’s turn our attention to how the body responds to sugar and define good sugars and bad sugars. When we eat sugar, amylase (an enzyme in saliva) cuts sugars into smaller parts. Most of the sugars we consume are initially broken down by the three primary types of amylase. In addition to this we have specific enzymes that help to break down sugars. For example:

• Maltose is broken down by maltase
• Lactose is broken down by lactase and so on

Once sugars are broken down into glucose they can be absorbed through the lining of the small intestine into the bloodstream. In plant sugars the additional components, like fiber in the form of cellulose and water soluble vitamins, must be cut away from the sugar molecule in order for the sugar to be absorbed. In other words the **simpler the sugar the faster it is absorbed into the blood**. The effect of sugar on the body can be measured by the Glycemic index.

The **Glycemic index** (GI) is the common measurement used to determine the amount of sugar found in the blood after eating carbohydrates. Foods are rated on a scale from 0-100. Those foods closest to 100 are rapidly absorbed and increase blood sugar sharply, which also increases insulin secretion. Foods lower on the scale will have a more gradual effect on blood sugar. The GI is determined by averaging and standardizing the effect of eating 50 grams of carbohydrates and determining the blood sugar response curve for a two hour period. Here are some examples of the GI for certain foods:

• Glucose: 100
• White bread: 70-90
• Whole grain bread: 55
• Grapefruit: 25
• Garbanzo beans: 10
A GI below 50 is low and a high GI of 79 and above is high. For more information check out this [Harvard Health Publication](https://www.health.harvard.edu/). In order to keep the blood sugar stable we favor foods that have a lower glycemic index.

While the glycemic index may provide information for simple sugars, the *glycemic load* (GL) provides a more precise measurement for a food’s effect on blood sugar levels. The GL takes into account all of a food’s components (vitamins, minerals, fiber, etc.) as well as the quantity consumed at a given time. A low GL is below 10 and a high GL is 20 and over. Here are examples of the GL for the same foods as listed above:

- Glucose: 20
- One slice of white bread: 15
- One slice whole grain bread: 12
- One grapefruit: 3
- One cup garbanzo beans: 3

The GL measures the total amount of carbohydrates in a food that are rapidly absorbed. The more vitamins, fiber and nutrients a food has, the slower its sugars are absorbed. Chronic conditions such as Type 2 Diabetes are caused by sugars that are absorbed too quickly, spiking the blood sugar and the insulin levels.

In summary, your blood sugar rises when you eat, but rises the most when you carbohydrates. The sugar in your food is absorbed through the wall of the small intestine and then it becomes cellular energy. Blood sugar naturally goes through peaks and valleys as you eat, but extreme peaks and valleys can create chronic health problems.

**What is a body’s reaction to sugar?**

**Understanding Insulin**

When the sugar from your meal enters the blood the pancreas secretes a hormone called *insulin*. Insulin acts as a key to the cell’s receptors, allowing them to receive sugar. Then the sugar will be converted into energy, which is necessary to repair and maintain the cell. If there is too much insulin in the blood at one time (i.e. the peak of the blood sugar curve is too high) then two things happen;

- The insulin receptors on the cell membranes become less receptive to insulin and they may even disappear over time as they are no longer needed because the cell is constantly saturated with sugar.
- The excess sugar that is not able to be absorbed into the cell is stored as fat.

When the cells are saturated with sugar and insulin is no longer binding to the cell membrane of the cells to let sugar into the cell, but instead is circulating in the blood stream you are no longer able to absorb sugar and this is called *insulin resistance*. 
In addition to insulin’s function as a fat storage and energy utilization hormone it also stimulates growth of the cells. If blood sugar dips too low, then you may feel tired, overwhelmed, grumpy or spacey which is called hypoglycemia. It is interesting to note that hyperglycemia (a peak in blood sugar) can result in the same symptoms.

Normal fasting blood sugar is considered to be 75-95 mg/dc. Blood sugar levels above or below that reference range are the peaks and valleys that cause harm. It has been found that people with impaired glucose absorption are twice as likely to die young. (Lerner, 1996)

**How bad can it be?**
Sugar’s primary affect on the body is as an antinutrient. As sucrose (table sugar) contains no minerals, fats, proteins or enzymes it requires certain key minerals to be digested. These are calcium, magnesium and B vitamins. So what do these key nutrients do in the body?

**Calcium and Magnesium:** Calcium is one of the building blocks responsible for the creation of bones and teeth. It also plays a primary role in blood clotting, muscle contraction and nerve conduction. In order for calcium to be absorbed by the body there must be adequate levels of vitamins D, A, E, K and magnesium. Magnesium’s functions are similar to calcium as it is responsible for bone health and muscle relaxation (Campbell-McBride, 2010).

**B Vitamins:** There are many types of B vitamins, but the primary B vitamin affected by sugar is thiamine. Thiamine is responsible for energy, composure and clear headedness. It is also important in detoxification as it activates phase one break down of toxins in the liver.

If you have over overindulged in a bag of cookies you may have found yourself feeling hot and urinating more frequently. When there is too much sugar in the blood it is broken down and eliminated. The nutrients help the sugar to be broken down by binding to them and then the sugar is eliminated from the body to maintain homeostasis. Urination and sweating increase after sugar consumption and these key nutrients can be up to 300% in the urine and sweat over a twelve-hour period. The nutrient depletion that is the result upsets endocrine function, acid/alkaline balance and hydrochloric acid production in the stomach. This causes the following:

- Cramps
- Muscle tightness
- Low Blood Pressure
- PMS
- Low Back Pain
- Attention Deficit Disorder
- Osteoporosis
- Asthma
- Depression (Lan, 1996)

Once sugar consumption has been halted foods can help replace these nutrients. Calcium containing foods include turnip greens, spinach, collard greens, basil, thyme, cinnamon and sesame. There is
magnesium in pumpkin seeds, spinach, chard, salmon, sunflower and sesame seeds. Most vegetables, whole grains and beans are high in B vitamins. Bone broths, seaweed and leafy greens are high in all types of trace minerals.

Other systems compromised by sugar

**Immune system**
The immune system (IS) is primarily composed of the white blood cells, which are found in the blood and in the lymphatic fluid. The primary activity of white blood cells is to digest and dispose of bacteria and its effectiveness is directly linked to the amount of sugar consumption. (Sanchez, 1973) As little as 1 teaspoon of sugar can depress the IS for up to 5 hours. (Sears, 1999) Sugar also competes with vitamin C, a potent antioxidant, for absorption into the cells. This creates widespread inflammation in the body.

**How does inflammation affect the body?**
Inflammation is a natural response initiated when there is trauma to the tissues of the body. Usually it clears up in about 48 hours. Long term sugar consumption can lead to chronic inflammation which has wide ranging effects. One of the most life threatening aspects of inflammation is cancer. It is through inflammation that sugar is able to feed tumor growth. Since cells require glucose as energy, cancer cells are fed by sugar as well (Block, 2009). This is likely why blood sugar has been correlated with breast cancer and its prognosis or relative progression. (Bennett, 2006)

**Diabetes and metabolic syndrome**
The pancreas secretes hormones such as insulin in order to balance blood sugar. When the pancreas does not secrete enough insulin to allow sugar to be absorbed into the cells this is called Type 1 diabetes. When the cells no longer respond properly to insulin (remember insulin resistance) Type 2 diabetes is the result. Type 1 diabetes is characterized by a misfiring of autoimmune cells that result in the destruction of the insulin secreting cells within the pancreas. Type 2 diabetes is when the body develops insulin resistance over time and the cells membranes no longer respond to the insulin and so the sugar in the blood is not absorbed inside the cell to be used as fuel.

Many traditional or ancestral diets consisted of 80 grams of carbohydrates per day and the typical American consumes over 360 grams per day. Overconsumption of simple sugars leads to insulin resistance, and is the cause of Type 2 diabetes, metabolic syndrome, syndrome x and correlates strongly to late onset Type 1 diabetes.

For example, there is evidence that type 2 diabetes leads to heart disease and that it is a much bigger threat than high cholesterol (Katz, 2013). Here’s what happens. When sugar is not absorbed into the cells it stays in the blood stream, which over time can damage blood vessel walls. This damage creates an inflammatory response in the blood vessel leading to plaques or hardening of the vessels.

The insulin resistance also leads to obesity, now referred to as diabecity because it goes in hand with diabetes (Hyman, 2012). When cells are saturated with sugar then they do not respond to the insulin in the blood. If insulin doesn’t open the gateway into the cell then the sugar has nowhere to go so it is stored as fat.
**Mood and Brain Health**
There are three primary players when it comes to how our food affects the brain. These are neurotransmitters; serotonin, dopamine and beta-endorphins. When blood sugar is balanced these three chemicals create the equilateral triangle of mood resulting in a happy, relaxed and resilient mind. But when our blood sugar is too low or too high, the mood is more like a scalene triangle—all sides are unequal. There are two primary kinds of neurotransmitters: excitatory and inhibitory. Excitatory neurotransmitters wake us up and are stimulating; inhibitory neurotransmitters help us drown out excess noise and calm us down. Let’s take a moment to discuss some of our neurotransmitters.

**SEROTONIN:** Serotonin is our primary inhibitory neurotransmitter. It is often called a “feel good chemical” because it quiets brain activity. When we are relaxed and peaceful we are more able to say “no.” The ability to say “no” helps us to inhibit violent tendencies, reduces anxiety, pacifies aggressiveness, remedies sleep disturbances and calms the symptoms of PMS.

Serotonin is manufactured in the body using three building blocks that are found in foods we eat. These are tryptophan, B vitamins and magnesium. Tryptophan, a vital amino acid plays an essential role in serotonin manufacturing. Sugar allows more tryptophan to cross the blood brain barrier to be converted into serotonin through a process called *hydroxylation*. This rise in serotonin normally inhibits impulses and appetite by stimulating a relaxed mood (Krakowski, 2003). Prolonged elevation of insulin levels disturbs brain chemistry and we become dependent on sugar for this serotonin induced relaxation. This can lead to complications with impulse control, hormone function and weight gain (Schwarzbein, 1999). If there are low amounts of tryptophan in the body, then serotonin will not be produced. In order to keep serotonin levels stable consume tryptophan rich foods like:

- Shrimp
- Tamari
- Mushrooms
- Cod, tuna, salmon
- Mustard greens, spinach
- Chicken
- Lamb
- Pumpkin seeds

Repetitive movements like yoga or sweeping also induce this sense of relaxation.

**BETA-ENDORPHINS:** Beta-endorphins are an inhibitory neurotransmitter that act like morphine for the brain and create what is often referred to as an “endorphin rush.” This “rush” facilitates our ability to manage pain (like morphine) and respond to stress (fight or flight). Morphine and beta-endorphins are both opiates. Beta-endorphin is called an *endogenous opioid* because it is an opiate manufactured within the body.

When our beta-endorphin levels are low our responses to pain or criticism are exaggerated and the perceived emotional and physical threat is too much for our coping mechanisms. This often leads to low self esteem and a feeling of being stuck. The sweet taste on the tongue can temporarily increase beta-endorphin levels. Therefore, we may crave sweet food if beta-
Endorphin levels are low. Another time that we crave these foods is after ovulation because the beta-endorphin levels drop, which is why many women crave alcohol or chocolate at this time.

Morphine and heroine are familiar painkillers. Like sugar, they temporarily increase our level of beta-endorphins. This leads to a higher pain threshold, especially in regards to emotional and social pain, thus boosting our level of self worth. Over time heroine, morphine and sugar addicts become dependent on their drug of choice to initiate feelings of self worth. It can take up to six months to retrain the body to experience improved self esteem without heroine (DesMaisons, 2002). This process is dependent on eliminating these three imbalances:

- Low Blood sugar
- Low serotonin levels
- Low beta-endorphins

Instead of getting overweight, this sinister combination of imbalances allows you to run on adrenaline eventually leading to adrenal fatigue. The best solution is to build self-esteem and choose low glycemic sweeteners and foods like stevia and blueberries.

**Dopamine:** Dopamine is the primary excitatory neurotransmitter and it is often referred to as the “Reward” chemical. That is because is governs the feeling of pleasure among other things such as motivation, alertness and bliss. The creation of dopamine is dependent on an amino acid called tyrosine. When there is adequate tyrosine in the brain, dopamine can easily be synthesized in response to a sweet taste on the tongue. In order to ensure that you have enough tyrosine consume foods like:

- Banana
- Almonds
- Avocado
- Pumpkin, sesame seeds
- Vitamins A and D in foods like fermented cod liver oil

Often the feeling of needing a reward will stimulate us to crave sugar in order to secrete the dopamine associated with that feeling.

**Inflammation: The cause of disease**

Modern science believes that chronic inflammation is the leading cause of the most prevalent diseases in the US. There is evidence that systemic inflammation leads to:

- Dementia
- Autism
- Anxiety
- Cancer
- Heart disease
- Autoimmune diseases
- Autism

The process of inflammation overlaps between being either localized, serious, or chronic. Localized inflammation is the body’s natural response to trauma. It helps to heal the area by improving circulation. When there is a more serious trauma to the body, the Immune System sends white blood
cells to the area in order to establish balance. This shunts blood from the internal organs and other areas of the body into the injured area. Then, after the trauma is healed, homeostasis is re-established.

When the inflammation is chronic, low grade and systemic, on the other hand, these additional chronic diseases can develop:

- Diabetes
- Eczema
- Asthma
- Attention Deficit Disorder

These diseases arise because the body is in a state of chronic repair, so it is not able to mobilize adequate resources to deal with acute or severe inflammation. Therefore, *Chronic inflammation becomes the root of chronic disease.*

**WHAT CAUSES THIS INFLAMMATION?**

Since inflammation is an immune system response and over 70% of the immune system resides in the gut, we look there for our protection against invaders. With food allergies or nutritional deficiencies, food choices may result in gas, bloating, diarrhea, constipation or high insulin levels, sending our body into high alert. This is where chronic inflammation begins and why focusing on what we eat is such an important aspect of health.

*Sugar is Dangerous*

Sugar can lead to a host of different diseases because it leads to chronic inflammation and mood destabilization when consumed in excess or depending on the type of sugar that is consumed. As mentioned earlier the key to balanced blood sugar is to have food digested more slowly and to avoid simple sugars that spike the blood sugar. Avoiding refined sugars and eating sugars in conjunction with fat, fiber and protein can help.

**Which sugar to choose**

We understand now that our brain chemistry relies on the sweet taste, so we need to choose foods that have a low glycemic load or glycemic index. These are referred to as *low glycemic foods.* Remember that sometimes sweeteners with a high glycemic index can have vitamins, minerals or fiber which slows down their absorption and provides beneficial nutrients to the body. The chart below provides some basic guidelines on the glycemic index of different sugars.

<table>
<thead>
<tr>
<th>Sweetener</th>
<th>Type</th>
<th>Glycemic Index</th>
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</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>Sugar</td>
<td>100</td>
</tr>
<tr>
<td>Sucrose</td>
<td>Sugar</td>
<td>65</td>
</tr>
<tr>
<td>Blackstrap Molasses</td>
<td>Sugar Extract</td>
<td>55</td>
</tr>
<tr>
<td>Maple Syrup</td>
<td>Natural Sugar</td>
<td>54</td>
</tr>
<tr>
<td>Honey</td>
<td>Natural Sugar</td>
<td>50</td>
</tr>
<tr>
<td>Sorghum Syrup</td>
<td>Natural Sugar</td>
<td>50</td>
</tr>
<tr>
<td>Sugar</td>
<td>Category</td>
<td>Glycemic Index</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Lactose</td>
<td>Sugar</td>
<td>45</td>
</tr>
<tr>
<td>Cane Juice</td>
<td>Sugar Extract</td>
<td>43</td>
</tr>
<tr>
<td>Barley Malt Syrup</td>
<td>Modified Sugar</td>
<td>42</td>
</tr>
<tr>
<td>HSH</td>
<td>Sugar Alcohol</td>
<td>35</td>
</tr>
<tr>
<td>Coconut Palm Sugar</td>
<td>Natural Sugar</td>
<td>35</td>
</tr>
<tr>
<td>Maltitol</td>
<td>Sugar Alcohol</td>
<td>35</td>
</tr>
<tr>
<td>Brown Rice Syrup</td>
<td>Modified Sugar</td>
<td>25</td>
</tr>
<tr>
<td>Agave Syrup</td>
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<tr>
<td>Xylitol</td>
<td>Sugar Alcohol</td>
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<tr>
<td>Yacon Syrup</td>
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</tr>
<tr>
<td>Luo Han Guo</td>
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</tr>
<tr>
<td>Thaumatin</td>
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<td>0</td>
</tr>
<tr>
<td>Stevia</td>
<td>Natural Sweetener</td>
<td>0</td>
</tr>
<tr>
<td>Sucralose</td>
<td>Artificial Sweetener</td>
<td>0</td>
</tr>
</tbody>
</table>


**Recommendations**

The worst sugars are refined white sugars, which come from sugar beets or sugar cane, and high fructose corn syrup. Avoid these whenever possible and look at labels and serving size to determine how much sugar is in the food that you are eating. As we mentioned before traditional diets had less than 80 grams of carbohydrates a day in the form of grains, fruits and vegetables. In addition to these, also avoid any artificial sweeteners like sucralose and aspartame although they have a low glycemic index they have been shown to cause cancer.

Also look at other ingredients, *if a treat has more than six ingredients it is best to avoided*. In general the best foods tend to be in the perimeter of the store: produce, bulk foods, meat department, etc. Stay on the perimeter as much as possible.

Sugars with higher glycemic index but beneficial nutrients are coconut sugar, maple syrup and molasses. Because of the additional nutrients they have a lower glycemic load and will be less likely to spike the blood sugar. A small sweet treat can be safely eaten about once a month for most people. Be careful not to consume too much at one time as a high quantity of healthy sugars is as bad as the refined sugars in terms of the inflammatory response that is initiated. Xylitol, which is a sugar alcohol, has a low glycemic index. While it is great for whitening the teeth, it is highly refined and is best avoided it in your food. However, it is fine in gum or toothpaste. Agave nectar, while having a low glycemic index, is also extremely refined and only has as much nutrition as corn syrup. Therefore, it is not recommend either. Perhaps the best natural sweetener is stevia because it has a low glycemic index. Choose a variety of stevia that is the least refined like the liquid stevia or the actual stevia leaf powder.

**Making Change that Sticks!**

Now that you understand sugar’s effects on the body, I imagine you are inspired to make a change. Your sugar habits have not grown overnight and so it is best to make change slowly. Look at this as a four-
year project, just like college. To begin, keep a food journal to document what you eat when you eat it and how it makes you feel emotionally and physically. Try finding an app that can help you with this. Some apps I like are:

- Mindfulness bell
- Optimism
- Positive Thinking
- Rise Up + Recover
- What’s my M3


Food Journaling will help you to wake up to your habitual patterns and behaviors. The knowledge you will gain will motivate you set and achieve your goal. Remember, this is an experiment and you are looking for ways to improve your health and mood. If something doesn’t work, come up with a new hypothesis and test it in a rigorous scientific way. This will provide the knowledge for self reflection and understanding; the ultimate goal of any dietary change. Lastly tell your friends and family or announce it on your blog. When you go public it holds you accountable to the changes. Remind yourself that this is a process. Sometimes you may backslide slightly. Use those instances as an opportunity to re-inspire your commitment and look over your goals for going sugar free (Appleton, 2008).

If you are inspired to make lasting change but you need help, please contact [Rhythm of Healing](http://www.healthline.com/health-slideshow/top-eating-disorder-iphone-android-apps#promoSlide) for some one on one guidance and support.