Since 2013

The Case of Sugar

COMFORT KETO

By MyKetoPal

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What Is a Carbohydrate?

In short, carbohydrate = Sugar

- Carbohydrates are the most abundant bio-molecule on earth.
- All carbohydrate bio-molecules consist of carbon, hydrogen and oxygen atoms.
- **Carbohydrates** are the body's principal energy source.
- 1 gram of carbohydrate contains 4 calories.

Protein calories	1 Gram = 4
Carbohydrates calories	1 Gram = 4
Fat calories	1 Gram = 9

- Carbohydrates are called *saccharides*, meaning sweet in Greek.
- All *sugars*, *starches* (grains, legumes) are ***simple carbohydrates***.
- ALL ***simple carbohydrates*** (sugars and starches) in the food break down with ease into the most basic type of sugar, called **glucose**.
- All *fibers* found in fruits, grains, vegetables and dairy products are ***fiber carbohydrates*** (also known as complex carbohydrates).

Nutrition Facts

Serving Size (358g)
Servings Per Container

Amount Per Serving

Calories 110 Calories from Fat 15

% Daily Value*

Total Fat 2g 3%
Saturated Fat 0g 0%
Trans Fat 0g
Cholesterol 10mg 3%
Sodium 550mg 23%
Total Carbohydrate 17g 6%
Dietary Fiber 9g 36%
Sugars 3g
Protein 10g

Vitamin A 300% • Vitamin C 140%
Calcium 35% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less Than	65g	80g
Saturated Fat	Less Than	20g	25g
Cholesterol	Less Than	300mg	300 mg
Sodium	Less Than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

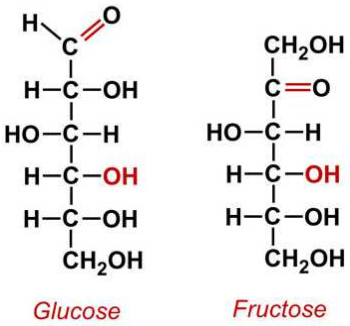
In ketogenic diet we count the "**net**" carbs. This means, we deduct the dietary fiber from the "total carbs" listed on the Nutrition facts label. The remaining carb count is the simple carbs only.

In this example as illustrated here, the simple carbs are 8 grams (net carbs).

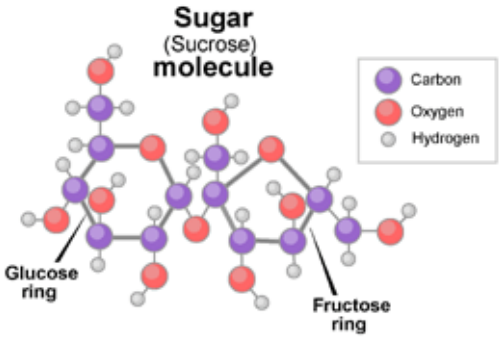
17 grams (Total carbs) - 9 grams (dietary fiber) = 8 grams (net carbs).

- ALL carbohydrates are either single or multi molecules of sugar, all chemically linked together, forming chains.
- **Glucose** is the simplest form of sugar, thus the basic carbohydrate. That is why, our digestive system breaks down all carbohydrates into this form of basic sugar (glucose) for easy absorption.
- In plants, glucose is stored as starch, and in animals as glycogen.

- **Glucose** and **fructose** are similar:
  - they are both mono-saccharides (single sugar carbohydrates),
  - neither contain essential nutrients, and
  - both provide only "empty" calories.



- **Sucrose** (table sugar) is a two-chain carbohydrate (disaccharide formed when two mono-saccharides are joined).
- Sucrose (table sugar) contains one molecule each of *glucose* and *fructose*.
- Since sucrose is half *glucose* and half *fructose*, it has an intermediate **glycemic index** (GI).
- Only the *glucose* portion of sucrose raises blood glucose appreciably.



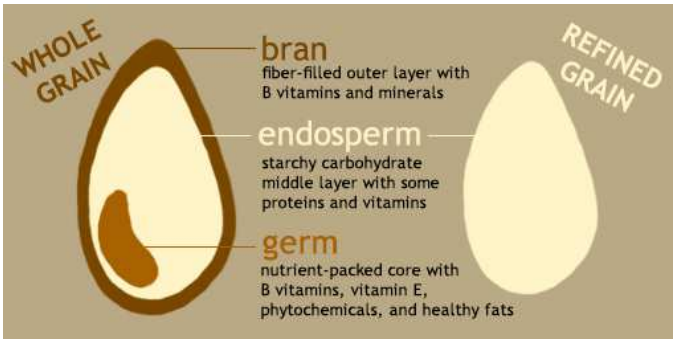
The **Glycemic Index** measures the *blood glucose raising ability* of various carbohydrates.

Pure glucose will obviously cause the largest rise in blood glucose and is therefore given the maximal GI value of 100. All other foods are measured against this yardstick.

Just a quick footnote here:

The illustration here shows the difference between a **refined grain** (refined carbs) and a **whole grain**.

Refined grain is practically empty of all nutrients, and provides only "empty" calories from starch.

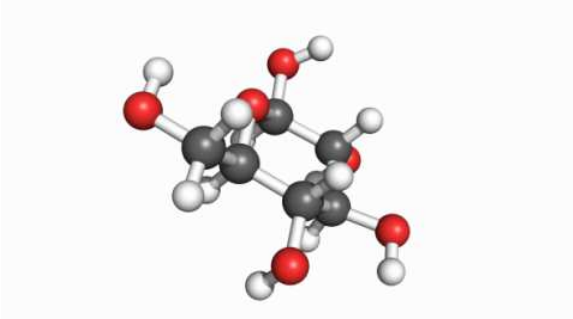


Glucose: The Simplest Sugar

Our body is able to burn glucose easily as fuel.

When consumed, all complex carbohydrate molecules (except insoluble fibers) are broken down into glucose in our digestive system.

Being a mono-saccharide, and the smallest sugar molecule, glucose can penetrate our cell membranes and blood-brain barrier as body's main fuel when a person is on a carbohydrates-inclusive-diet.

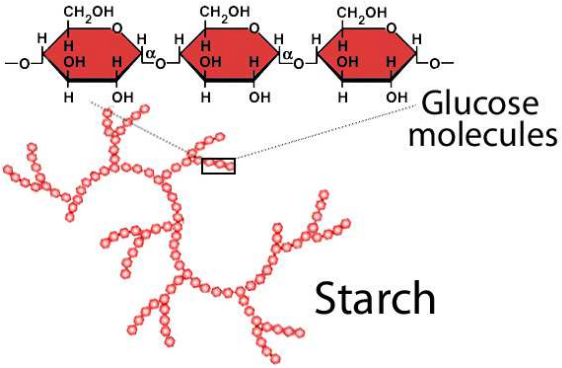


Corn Starch Is Glucose

Flour is made by milling grains and roots.

Starch is a component of flour along with other parts of the grain seed such as fibrous hull (bran), and other proteins. Flour contains gluten and corn starch does not.

Another name for cornstarch is corn flour. Corn starch is a pure starch compared to flour from other grains.

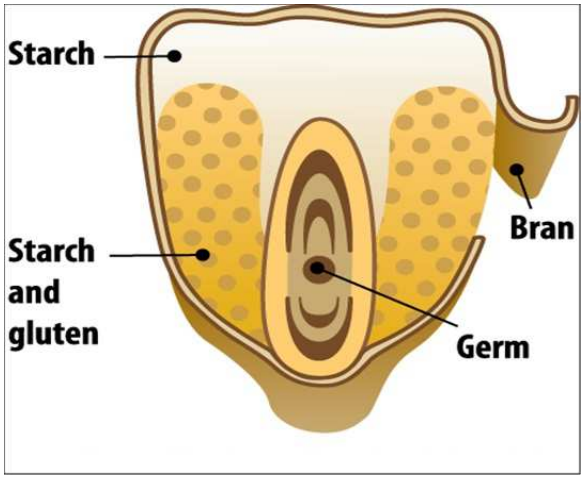


Quick Info on Starch:

- Starch from ALL plants are chemically identical. Glucose is its building block.
- Glucose molecules bond to one another, forming long chains.
- Yet, the same chemical formula may look different and create completely different products. The important factor is the configuration of the long chains.
- For example both cellulose and starch are made of glucose, but starch can be easily digested by humans, while cellulose can't.
- When starch is consumed, our digestive enzymes immediately break it down into its constituent glucose. Within minutes of consumption, the long chains of glucose are rapidly broken down by enzymes into individual glucose molecules, and absorbed into the digestive tract.

Pure corn starch is glucose!

While it's possible to extract glucose from other plants, it's "cheapest" to obtain glucose from corn starch.



Kernel of corn

Glucose can be used by virtually every cell in the body, and circulates freely throughout the body.

In a healthy body, the ingested glucose is metabolized as follows:

- Eighty percent (80%) is metabolized the tissues of the body (other than the liver).
- Twenty percent (20%) is converted by the liver into glycogen for storage in the liver and muscles.
- Very little glucose remains as substrate for new body fat production.

To put it simply, in nature sugar means rapid energy and starch means energy storage. In the process of digestion, starches get broken down into sugar (glucose). Glucose can form starch in the human organism (glycogen). So these two substances have a lot in common.

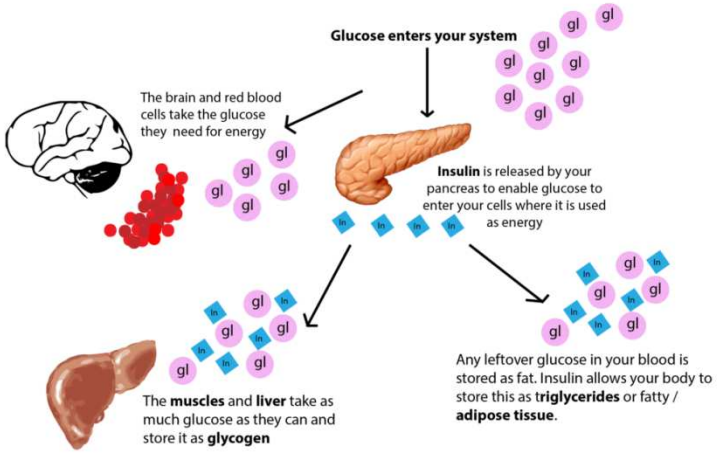
Pure glucose tastes much sweeter than starch.


Pure Glucose

In the brain, glucose is the preferred energy source. Muscle cells greedily import glucose from the blood for a quick energy boost. Certain cells, such as red blood cells, can use only glucose (they don't metabolize fats).

Glucose is stored in the liver and the muscles in form of glycogen-for immediate release when needed. Glycogen is a form of starch in which the human body stores sugar.

If glycogen stores run low, the liver pulls back glucose from the amounts circulating in the blood stream and makes new glucose from stored and available proteins in the body via the *gluco-neo-genesis* process.



The Other Simple Sugar: Fructose

Fructose is the naturally occurring sweetest carbohydrate mono-saccharide (single molecule sugar). It is in fruits, some vegetables and honey.

Pure fructose is generally not consumed. Sometimes it can be found as an ingredient in processed foods.

Fructose is one of the basic components in the production of sucrose (table sugar), and High Fructose Corn Syrup production.

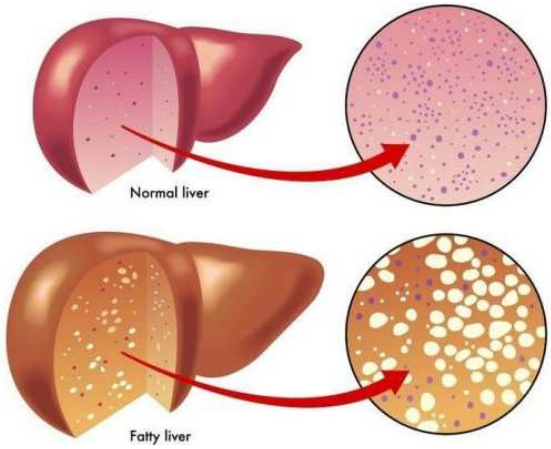
Foods high in net fructose

Fructose does not circulate in the blood. Fructose is targeted like a guided missile to the liver for processing. Fructose has no mechanism for easy storage either. It is metabolized to fat, which cannot be easily reversed.

Eating fructose does not appreciably change the blood glucose level, and therefore fructose has low glycemic index value. Fructose neither raises blood glucose nor insulin. This sure sounds healthy but **fructose has a hidden dark property**.

The Case Against Fructose

Fructose is particularly malevolent to human health compared to glucose due to its unique metabolism within the body. The toxicity of fructose cannot be seen by looking at the blood sugar levels, but only by looking at the slow accumulation of fat in the liver. **The key is the fatty liver.** This fatty liver is crucial to the development of insulin resistance.



Whereas almost every cell in the body can use glucose for energy, **no cell in the human body has the ability to use fructose**. The brain, muscles and most other tissues cannot use fructose directly. Once inside the body, only the liver can metabolize fructose.

Large quantities of ingested fructose goes straight to the liver, putting significant pressure on this vital organ. Fructose is 20 times more likely to cause fatty liver (the key cause of insulin resistance) compared to glucose alone.

The liver metabolizes fructose into glucose, lactose and glycogen. When the glycogen stores (in the liver and muscles) are full, the excess fructose is converted into liver fat. This fatty liver is crucial to the development of insulin resistance. When the fat stores in the liver are full (full scale fatty liver), the excess fructose is converted into visceral fat.

High Fructose Corn Syrup (HFCS)

Historically, food and beverage producers have used HFCS due to it being the "lowest-cost" alternative to sugar. HFCS is a very sweet derivative of corn starch.

We already mentioned that the most common and cheapest source of industrial glucose is corn starch.

This is the surprising story of how HFCS is produced, in short !

Step 1 . Breaking corn starch down using enzymes into individual glucose molecules forms corn syrup.

Step 2 . To create High Fructose Corn Syrup (HFCS), manufacturers add enzymes to corn syrup that convert some of the glucose to fructose.

Step 3 . The amount of fructose in HFCS varies by design and purpose as food additive.

The $4bn (2018) per year HFCS production industry is slowly declining as the health-conscious individuals have become wary of consuming products with HFCS. Main products are:

- HFCS-55 (55 % Fructose, 45 % Glucose),
- HFCS -42 (42 % fructose, 53 % glucose) and HFCS with higher fructose content.

Corn kernels >>> Corn Starch + Enzymes >>> Corn Syrup + Enzymes >>> HFCS

Fructose overconsumption causes fatty liver and leads directly to insulin resistance. Actually, it only takes six days of excess fructose to cause insulin resistance. It only takes eight weeks for diagnosis of pre-diabetes.

Biomedical research clearly shows that the increase in obesity throughout the last three decades closely mirrors the increased use of High Fructose Corn Syrup in the modern western diet, whether the fructose came from sucrose or from corn syrup.

10 Reasons to Limit Your Fructose Consumption (Including HFCS)

1. Fructose can only be metabolized by the liver and can't be used for energy by your body's cells. It's therefore not only **completely useless for the body**, but is also a toxin in high enough amount because the job of the liver is to get rid of it, mainly by transforming it into fat and sending that fat to our fat cells.

2. Excess fructose damages the liver and leads to insulin resistance in the liver as well as fatty liver disease. In fact, **fructose has the same effects on the liver as alcohol** (ethanol), which is already well known as a liver toxin.

3. Fructose reacts with proteins and polyunsaturated fats in our bodies 7 times more than glucose. This reaction creates AGEs (advanced glycation end-products), which are compounds that create oxidative damage in our cells and ultimately lead or **contribute to inflammation** and a host of chronic diseases.

4. Fructose increases uric acid production, which, in excess, can cause **gout**, **kidney stones** and precipitate or aggravate **hypertension**.

5. While most of your body's cells can't use fructose as a source of energy, some bacteria in your gut can. Excess fructose can create gut flora imbalances, promote bacterial overgrowth and promote the growth of **pathogenic bacteria**.

6. In part because of the damage done to the liver, chronic excess fructose causes dyslipidemia, which means that your blood lipid markers tend to shift towards numbers that indicate a **risk for heart disease**.

7. Fructose rapidly causes **leptin resistance**. Leptin is a hormone that controls appetite and metabolism to maintain a normal weight. Leptin resistant people tend to gain body weight and become obese really easily.

8. Excess fructose alone can cause all the problems associated with the **metabolic syndrome** (diabetes, obesity, heart disease).

9. **Cancer cells thrive** and proliferate very well with fructose as their energy source.

10. Excess fructose also **affects brain function**, especially as it relates to appetite regulation. It has also been shown to impair memory in rats.

Sucrose - Our Most Common Table Sugar

Sucrose (table sugar), the most well-known sweetener, is made by crystallizing sugar cane or beet juice.

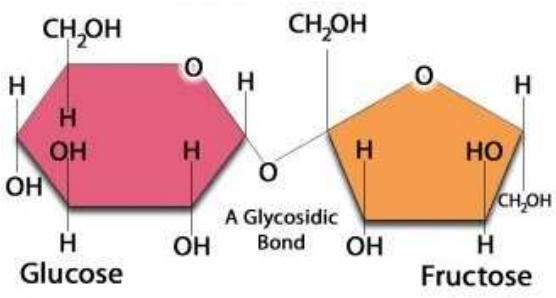


Table sugar, also known as "*sucrose*" is composed of one molecule of *glucose* linked to one molecule of *fructose*, an exact one-to-one ratio. Together, they form a di-saccharaide molecule containing fifty (50) percent glucose and fifty (50) percent fructose.

Honey is a common nutritive sweetener with an approximately one-to-one ratio of *fructose* to *glucose*. Same as *sucrose*.

Fruit and nectar-based sweeteners may have more fructose than glucose, especially those that come from apples and pears.

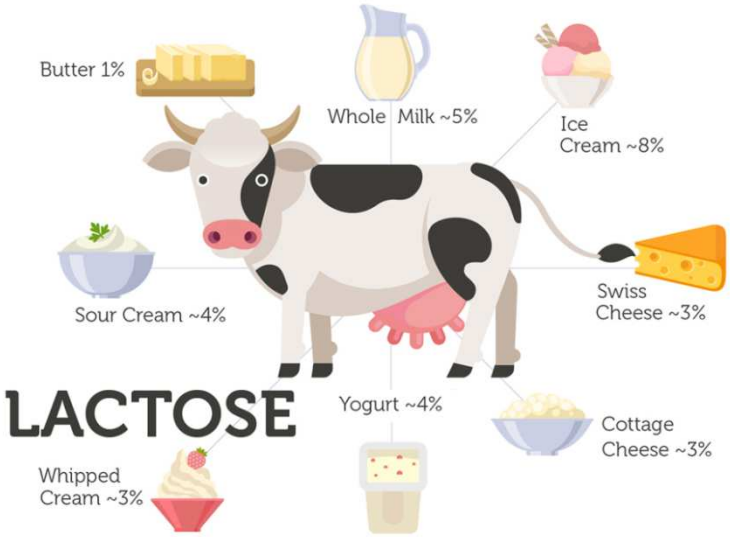
The proportion of fructose to glucose in both HFCS 42 and HFCS 55 is similar to that of sucrose.

Differences Between Sucrose and HFCS

The primary ***differences between sucrose and HFCS*** are:

- HFCS contains water, sucrose doesn't.
- In sucrose, a chemical bond joins the glucose and fructose.
- In HFCS, no chemical bond joins the glucose and fructose. These molecules in set percentages float freely.
- Once a person consumes sucrose, the stomach acid and gut enzymes rapidly break down the glucose and fructose bond.
- In HFCS the glucose and fructose float freely as there is no chemical bond between the two elements.

Lactose: The Sugar from Milk



Lactose is the sugar from milk, making up around 2–8% of the milk by weight. There is 12 grams of lactose in 8 ounce of milk.

Lactose is a di-saccharide sugar molecule composed of galactose and glucose. Like glucose, *galactose* is absorbed as fuel. Lactose is not added to food products except in infant formula to match human milk.

The intestinal *villi* secrete the enzyme lactase (β-D-galactosidase) which cleaves the lactose molecule into the simple sugars glucose and galactose.

By descent, 70% of western European adults can drink milk compared with 30% of people from Africa, far eastern Asia and Oceania. In people who are lactose intolerant, lactose is not broken down and provides food for gas-producing gut flora, which can lead to diarrhea, bloating, flatulence, and other gastrointestinal symptoms.

Even if you're sensitive to most dairy products, that doesn't mean you have to avoid all cheeses.

You can tell low lactose levels: Check the nutrition label. Since lactose is the sugar found in milk, the fewer grams of sugar on the label means lower lactose content. For example, there is 0.2 grams in 100 grams of cheddar cheese, versus the 6 grams in feta.

Here are some tips:

- Natural, aged cheese such as Cheddar, Parmesan and Swiss have less than 0.5 gram lactose in 100 grams serving and can be digested by many people with lactose intolerance. During the cheese making process, most of the lactose is drained off with the whey (the liquid portion). The small amount that remains in the curd is changed to lactic acid during ripening (aging) of cheese. Only trace amounts of lactose remain.
- Fresh cheeses contain more lactose than aged cheeses. Cheeses such as mozzarella, cream cheese and ricotta have less than 5 grams of lactose in 100 grams serving. Cottage Cheese, generally has additional milk or cream mixed with the curd. Therefore, has more lactose.
- Processed cheese foods and cheese spreads are made by melting natural cheese to stop the aging process and then adding other ingredients, including whey or milk. Cheese foods and cheese spreads contain lactose.

Natural Sweeteners

Natural Sweeteners	Reason for Concern	Effects
High Fructose Corn Syrup	Highest GI, spikes blood sugar fastest, natural sweetener made from corn starch, has 40-55 and higher % fructose	RED
Maple & Table Syrup	High GI, spikes blood sugar fast, natural sweetener made from sap of sugar maple, has 60+ % sucrose	RED
Agave Syrup (Nectar)	High GI, spikes blood sugar fast, natural sweetener made from blue agave, has 55+ % fructose	RED
Honey	High GI, spikes blood sugar fast, natural sweetener produced by bees from polen, has 38 % fructose, 30 % glucose, 7 % maltose	RED
Maltose	High GI, spikes blood sugar fast, natural sweetener made of 2 molecules of glucose	RED
Sucrose (white or brown table sugar) =Glucose + Fructose	High GI, spikes blood sugar fast, natural sweetener gained from sugar cane or sugar beet; white sugar has 99 % sucrose, brown sugar has 93 % sucrose	RED
Fructose	High GI, spikes blood sugar fast, more difficult to metabolize than glucose, sweetest natural sweetener found in fruit and honey	RED
Coconut Sugar	Medium GI, raises blood sugar slower than sucrose, natural sweetener produced from the sap of the flower bud stem of the coconut palm, has 70–79 % sucrose, 9 % fructose, 3 % glucose	ORANGE
Truvia (brown or white) = Half sugar (sucrose) half stevia	Medium GI, raises blood sugar slower than sucrose, natural sweetener blend of sucrose and stevia, used for baking	YELLOW
Stevia/sweet leaf	Low GI, raises blood sugar very little, metabolized by the liver, benefits people with diabetes, natural sweetener derived from the leaves of stevia plant, has 30 to 150 times the sweetness of sucrose	GREEN