THE COMPLETE

GLUCOSE

GUIDE FOR BEGINNERS

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Introduction

glucose, or commonly referred to as blood sugar, is the form of energy circulating in your blood stream. Food is absorbed and metabolized by the organs in your body, by your enzyme and hormonal systems and eventually nourishes your body. Certain foods, such as carbohydrates and smaller parts of protein, are broken down to blood glucose. When you eat, insulin from your pancreas is activated to release glucose from the blood and transport it to the cells of the body to produce energy.

In a normal state, the body can carefully balance the amount of insulin and glucose and thus regulate blood glucose levels. Normal blood glucose levels are: fasting (before eating) 70-99mg/dl and 140mg/dl or fewer two hours after a meal. Normal A1c blood sugar test is 4-6 percent.

This complex regulation of blood glucose goes awry in diabetes. With type 1 diabetes, the pancreas no longer makes insulin, so blood glucose is very high (hyperglycemia) and cannot get into the cells that need fuel. People with type 1 diabetes need an exogenous (outside the body) source of insulin through insulin injections.

With type 2 diabetes, the pancreas makes insulin, but maybe not enough, or the insulin is unable to ade q uately transport the glucose into body cells. The blood glucose remains higher than normal. Diabetes is a progressive disease, so a combination of diet, exercise, oral and injectable medications can be used to control blood glucose levels.

The goal of diabetes treatment is to normalize the blood glucose levels with diet, exercise and medication. Your doctor may give you specific blood sugar goals based on your particular medical situation. However, there are two different sets of recommendations to guide your clinician. Your doctor may set higher levels goals in an attempt to “step down” your levels gradually, to avoid hypoglycemia episodes. Be sure to know your goals so you can assess your progress in controlling your diabetes.

CHAPTER 1

What is glucose?

You may know glucose by another name: blood sugar. Glucose is key to keeping the mechanisms of the body in top working order. When our glucose levels are optimal, it often goes unnoticed. But when they stray from recommended boundaries, you'll notice the unhealthy effect it has on normal functioning.

So what is glucose, exactly? It's the simplest of the carbohydrates, making it a monosaccharide. This means it has one sugar. It's not alone. Other monosaccharides include fructose, galactose, and ribose.

Along with fat, glucose is one of the body's preferred sources of fuel in the form of carbohydrates. People get glucose from bread, fruits, vegetables, and dairy products. You need food to create the energy that helps keep you alive.

While glucose is important, like with so many things, it's best in moderation. Glucose levels that are unhealthy or out of control can have permanent and serious effects.

How does the body process glucose?

Our body processes glucose multiple times a day, ideally.

When we eat, our body immediately starts working to process glucose. Enzymes start the breakdown process with help from the pancreas. The pancreas, which produces hormones including insulin, is an integral part of how our body deals with glucose. When we eat, our body tips the pancreas off that it needs to release insulin to deal with the rising blood sugar level.

Some people, however, can't rely on their pancreas to jump in and do the work it's supposed to do.

One way diabetes occurs is when the pancreas doesn't produce insulin in the way it should. In this case, people need outside help (insulin injections) to process and regulate glucose in the body. Another cause of diabetes is insulin resistance, where the liver doesn't recognize insulin that's in the body and

continues to make inappropriate amounts of glucose. The liver is an important organ for sugar control, as it helps with glucose storage and makes glucose when necessary.

If the body doesn’t produce enough insulin, it can result in the release of free fatty acids from fat stores. This can lead to a condition called ketoacidosis. Ketones, waste products created when the liver breaks down fat, can be toxic in large q uantities.

How Your Body Makes Glucose

It mainly comes from foods rich in carbohydrates, like bread, potatoes, and fruit. As you eat, food travels down your esophagus to your stomach. There, acids and enzymes break it down into tiny pieces. During that process, glucose is released.It goes into your intestines where it's absorbed. From there, it passes into your bloodstream. Once in the blood, insulin helps glucose get to your cells.

Energy and Storage

Your body is designed to keep the level of glucose in your blood constant. Beta cells in your pancreas monitor your blood sugar level every few seconds. When your blood glucose rises after you eat, the beta cells release insulin into your bloodstream. Insulin acts like a key, unlocking muscle, fat, and liver cells so glucose can get inside them.

Most of the cells in your body use glucose along with amino acids (the building blocks of protein) and fats for energy. But it's the main source of fuel for your brain. Nerve cells and chemical messengers there need it to help them process information. Without it, your brain wouldn't be able to work well.

After your body has used the energy it needs, the leftover glucose is stored in

little bundles called glycogen in the liver and muscles. Your body can store enough to fuel you for about a day.

After you haven't eaten for a few hours, your blood glucose level drops. Your pancreas stops churning out insulin. Alpha cells in the pancreas begin to produce a different hormone called glucagon. It signals the liver to break down stored glycogen and turn it back into glucose.

That travels to your bloodstream to replenish your supply until you're able to eat again. Your liver can also make its own glucose using a combination of waste products, amino acids, and fats.

How do you test your glucose?

Testing glucose levels is especially important for people with diabetes. Most people with the condition are used to dealing with blood sugar checks as part of their daily routine.

One of the most common ways to test glucose at home involves a very simple blood test. A finger prick, usually using a small needle called a lancet, produces a drop that is put onto a test strip. The strip is put into a meter, which measures blood sugar levels. It can usually give you a reading in under 20 seconds.

What are the normal levels for glucose?

Maintaining glucose levels near the normal range is an important part of keeping your body running effectively and healthily.

People who have diabetes have to pay special attention to their glucose levels. Before eating, a healthy range is 90–130 milligrams per deciliter (mg/dL). After an hour or two, it should be less than 180 mg/dL.

There are a variety of reasons that blood sugar levels can shoot up. Some

triggers include:

• a heavy meal

• stress

• other illness

• lack of physical activity

• missed diabetes medications

What should you do if your levels are too high or too low?

In situations where your glucose level is too high, insulin will help to bring it down. For people with diabetes, too-high blood sugar is a sign that they may need to administer synthetic insulin. In less serious situations, physical activity can help lower your levels.

A glucose level is considered to be too low when it dips under 70 mg/dL. This condition is also known as hypoglycemia, and it has the potential to be very serious. Hypoglycemia can occur when people with diabetes skip their medication. It can also occur when people are eating less than normal and exercising excessively. Eating a meal or drinking juice can help to increase glucose levels. People with diabetes also often take glucose pills, which can be purchased over-the-counter at a pharmacy.

It’s possible for low blood sugar to result in a loss of consciousness. If this occurs, it’s important to seek out medical care.

What happens if your levels go unregulated?

There are long-term conse q uences for unregulated glucose levels. It can lead to a variety of conditions, including:

• neuropathy

• heart disease

• blindness

• skin infections

• problems in the joints and extremities, especially the feet

• severe dehydration

• coma

More serious complications include diabetic ketoacidosis and hyperglycemic hyperosmolar syndrome, both conditions related to diabetes.

People who are worried that they may have diabetes should seek immediate help from a doctor.

Sources of glucose

Our bodies convert food into energy. Although we get energy and calories from carbohydrate, protein, and fat, our main source of energy is from carbohydrate. Our bodies convert carbohydrate into glucose, a type of sugar.

See Illustration: How food affects blood sugar

Many foods contain a combination of carbohydrate, protein, and fat. The amount of each in the food we eat affects how q uickly our bodies change that food into glucose.

This is how different foods affect how our blood sugar levels:

• **Carbohydrate:** Includes bread, rice, pasta, potatoes, vegetables, fruit, sugar, yogurt, and milk. Our bodies change 100 percent of the carbohydrate we eat into glucose. This affects our blood sugar levels q uickly, within an

hour or two after eating

• **Protein:** Includes fish, meat, cheese, and peanut butter. Although our bodies change some of the protein we eat into glucose, most of this glucose is stored in our liver and not released into our bloodstream. Eating protein usually has very little impact on blood sugar.

• **Fat:** Includes butter, salad dressing, avocado, olive oil. We turn less than 10 percent of the fat we eat into glucose. The glucose from fat is absorbed slowly and it won't cause an immediate rise in blood sugar.

Even though we don't get much glucose from fat, a meal that's high in fat can affect how fast our bodies digest carbohydrate. Because fat slows down the digestion of carbohydrate, it also slows down the rise in blood sugar levels. This sometimes can cause a high blood sugar level several hours after eating.

For some people, this delayed reaction can be quite a surprise. For example, after eating a meal high in fat, a person might have a blood sugar reading that's close to normal before going to bed. But the next morning, he or she might have a fasting blood sugar that's over 200. This is because it took the body overnight to digest the carbohydrates in the meal.

The most important thing to remember is that eating balanced meals that combine protein, carbohydrate, and a small amount of fat can help keep your blood sugars from rising too high or too q uickly.

Carbohydrates, Proteins and Fats

Overview

The body uses three main nutrients to function— carbohydrate, protein, and fat.

These nutrients are digested into simpler compounds. Carbohydrates are used for energy (glucose). Fats are used for energy after they are broken into fatty acids. Protein can also be used for energy, but the first job is to help with

making hormones, muscle, and other proteins.

Carbohydrate (starches and sugars) • Breads

• Grains

• Fruits

• Vegetables

• Milk and yogurt

• Foods with sugar Broken down into glucose, used to supply energy to cells. Extra is stored in the liver.

Protein • Meat

• Seafood

• Legumes

• Nuts and seeds

• Eggs

• Milk products

• Vegetables Broken down into amino acids, used to build muscle and to make other proteins that are essential for the body to function.

Fat • Oils

• Butter

• Egg yolks

• Animal products Broken down into fatty acids to make cell linings and hormones. Extra is stored in fat cells.

After a meal, the blood sugar (glucose) level rises as carbohydrate is digested. This signals the beta cells of the pancreas to release insulin into the bloodstream. Insulin helps glucose enter the body's cells to be used for energy. If all the glucose is not needed for energy, some of it is stored in fat cells and in the liver as glycogen. As sugar moves from the blood to the cells,

the blood glucose level returns to a normal between-meal range.

Several hormones and processes help regulate the blood sugar level and keep it within a certain range (70 mg/dL to 120 mg/dL). When the blood sugar level falls below that range, which may happen between meals, the body has at least three ways of reacting:

• Cells in the pancreas can release glucagon, a hormone that signals the body to produce glucose from glycogen in the muscles and liver and release it into the blood.

• When glycogen is used up, muscle protein is broken down into amino acids. The liver uses amino acids to create glucose through biochemical reactions (gluconeogenesis).

• Fat stores can be used for energy, forming ketones.

How our bodies turn food into energy

All parts of the body (muscles, brain, heart, and liver) need energy to work. This energy comes from the food we eat.

Our bodies digest the food we eat by mixing it with fluids (acids and enzymes) in the stomach. When the stomach digests food, the carbohydrate (sugars and starches) in the food breaks down into another type of sugar, called glucose.

The stomach and small intestines absorb the glucose and then release it into the bloodstream. Once in the bloodstream, glucose can be used immediately for energy or stored in our bodies, to be used later.

However, our bodies need insulin in order to use or store glucose for energy. Without insulin, glucose stays in the bloodstream, keeping blood sugar levels high.

How the body makes insulin

Insulin is a hormone made by beta cells in the pancreas. Beta cells are very sensitive to the amount of glucose in the bloodstream. Normally beta cells check the blood's glucose level every few seconds and sense when they need to speed up or slow down the amount of insulin they're making and releasing. When someone eats something high in carbohydrates, like a piece of bread, the glucose level in the blood rises and the beta cells trigger the pancreas to release more insulin into the bloodstream.

See Illustration: How Insulin Works

Insulin opens cell doors

When insulin is released from the pancreas, it travels through the bloodstream to the body's cells and tells the cell doors to open up to let the glucose in. Once inside, the cells convert glucose into energy to use right then or store it to use later.

As glucose moves from the bloodstream into the cells, blood sugar levels start to drop. The beta cells in the pancreas can tell this is happening, so they slow down the amount of insulin they're making. At the same time, the pancreas slows down the amount of insulin that it's releasing into the bloodstream. When this happens, the amount of glucose going into the cells also slows down.

Balancing insulin and blood sugar for energy

The rise and fall in insulin and blood sugar happens many times during the day and night. The amount of glucose and insulin in our bloodstream depends on when we eat and how much. When the body is working as it should, it can keep blood sugar at a normal level, which is between 70 and 120 milligrams per deciliter. However, even in people without diabetes, blood sugar levels can go up as high as 180 during or right after a meal. Within two hours after eating, blood sugar levels should drop to under 140. After several hours without eating, blood sugar can drop as low as 70.

Using glucose for energy and keeping it balanced with just the right amount of insulin — not too much and not too little — is the way our bodies maintain the energy needed to stay alive, work, play, and function even as we sleep.

Insulin helps our bodies store extra glucose

Insulin helps our cells convert glucose into energy, and it helps our bodies store extra glucose for use later. For example, if you eat a large meal and your body doesn't need that much glucose right away, insulin will help your body store it to convert to energy later.

Insulin does this by turning the extra food into larger packages of glucose called glycogen. Glycogen is stored in the liver and muscles.

Insulin also helps our bodies store fat and protein. Almost all body cells need protein to work and grow. The body needs fat to protect nerves and make several important hormones. Fat can also be used by the body as an energy source.

How diabetes changes the way this works

With diabetes, the body has stopped making insulin, has slowed down the amount of insulin it's making, or is no longer able to use its own insulin very well. When this happens, it can lead to several things.

For example, glucose cannot enter the cells where it's needed, so the amount of glucose in the bloodstream continues to rise. This is called hyperglycemia (high blood sugar).

When blood sugar levels reach 180 or higher, the kidneys try to get rid of the extra sugar through the urine. This makes a person urinate more than usual. It also makes a person feel thirstier because of the water he or she is losing by urinating so much.

When a person loses sugar in the urine, it's the same as losing energy because the sugar isn't available for the cells to use or store. When this happens, a person might feel tired, lose weight, and feel hungry all the time.

Other problems caused by high blood sugar include blurry vision and skin infections or injuries that don't heal. Women might have vaginal yeast infections more often.

When the body doesn't have enough insulin to help convert sugar into energy, it often starts burning body fat instead. This sounds like it might work well, but burning too much fat for energy produces a byproduct called ketones.

High levels of ketones can lead to a condition called diabetic ketoacidosis (DKA), which can be life threatening if not treated q uickly. DKA is more common in type 1 diabetes because the body has stopped making insulin.

Keep blood sugar levels under control

For a person with diabetes, the main focus of treatment is to control the amount of glucose in the body so that blood sugar levels stay as close to normal as possible.

People with type 1 diabetes need insulin shots as part of their care plan to control their blood sugar levels. Some people with type 2 diabetes can control their blood sugar levels with a healthy diet and exercise. However, many people with type 2 diabetes will need to include diabetes pills, insulin shots, or both in their diabetes care plans.

People with either type 1 or type 2 diabetes need to pay close attention to how blood sugar levels change at various times throughout the day in order to keep them as close to normal as possible. When blood sugar levels are close to normal, it means the body is getting the energy it needs to work, play, heal, and stay healthy.

Blood Glucose Levels and Diabetes

Your blood sugar level normally rises after you eat. Then it dips a few hours later as insulin moves glucose into your cells. Between meals, your blood sugar should be less than 100 milligrams per deciliter (mg/dl). This is called your fasting blood sugar level.

There are two types of diabetes:

• In type 1 diabetes, your body doesn't have enough insulin. The immune system attacks and destroys cells of the pancreas, where insulin is made.

• In type 2 diabetes, the cells don't respond to insulin like they should. So the pancreas needs to make more and more insulin to move glucose into the cells. Eventually, the pancreas is damaged and can't make enough insulin to meet the body's needs.

Without enough insulin, glucose can't move into the cells. The blood glucose

level stays high. A level over 200 mg/dl 2 hours after a meal or over 125 mg/dl fasting is high blood glucose, called hyperglycemia.

Too much glucose in your bloodstream for a long period of time can damage the vessels that carry oxygen-rich blood to your organs. High blood sugar can increase your risk for:

• Heart disease, heart attack, and stroke

• Kidney disease

• Nerve damage

• Eye disease called retinopathy

People with diabetes need to test their blood sugar often. Exercise, diet, and medicine can help keep blood glucose in a healthy range and prevent these complications.

foods that won't raise blood glucose

A healthy diet is essential to reversing prediabetes. There are no foods, herbs, drinks, or supplements that lower blood sugar. Only medication and exercise can. But there are things you can eat and drink that have a low Glycemic Index (GI).

This means these foods won’t raise your blood sugar and may help you avoid a blood sugar spike. In addition to diet changes, staying or becoming active is also important.

Learn which foods you can add to your diet plan. You may be able to prevent prediabetes or type 2 diabetes by adding more of these foods, spices, and drinks into your diet. Eat them as healthy alternatives to sugar, high GI carbohydrates, or other treats.

Avocados

Avocados are high in healthful fats, and may help to reduce the risk of metabolic syndrome.

Polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) are important components of a healthy blood sugar eating plan. They can improve insulin sensitivity. They can also help increase feelings of satiety, and have a healthy impact on blood pressure and inflammation. MUFAs are a key nutrient in avocados.

have shown avocados can lower the risk of metabolic syndrome. This is a group of risk factors that can increase the risk of diabetes. It can also raise the risk of blood vessel disease like heart disease and stroke.

Avocados also have a low GI. For a uni q ue, diabetes-friendly dessert, try making Oh She Glow's natural, no sugar added, raw avocado chocolate pudding.

Tuna, halibut, and fish with omega-3 fatty acids

Protein helps the body maintain and repair itself. Since protein doesn't impact blood sugar levels, it doesn't have a GI ranking and won't raise blood sugar levels. Protein also increases satiety, so relying on protein to feel full instead of bread, rice, or pasta may be a good way to manage your blood sugar.

Fish is a great source of protein. It's low in unhealthy fats and a good source of omega-3 fatty acids. Good options include:

• salmon

• trout

• albacore tuna

• mackerel

• halibut

Fish is also quick and easy to prepare. Season a filet with salt, pepper, and lemon and put it into an oven at 425°F (218°C). Bake for 20 minutes until the flesh is flaky.

Garlic

Garlic has potential to help manage blood sugar. Reports show garlic intake can lower fasting blood glucose, which is your blood sugar level when you haven't eaten. Similar studies also suggest that onions have positive effects on blood sugar levels.

Garlic doesn't have a GI ranking since it doesn't have carbohydrates and won't increase blood sugar levels. Add more garlic into your meals by trying this delicious garlic spread by An Edible Mosaic. It can last for a week and replace butter or salad dressing.

Sour cherries

While all fruits can raise blood sugar levels, but some have a lower GI score — like sour cherries. Sour cherries have a chemical called anthocyanins. Studies have produced experimental evidence that anthocyanins may protect against diabetes and obesity.

If you're a fan of fruits, try eating more sour cherries instead of bananas, pears, and apples. If you're planning dessert, skip the peach cobbler and try this paleo, no added sugar cherry crisp by I Breathe, I'm Hungry. Be sure to use sour cherries since regular cherries have a moderate to high GI score.

Apple cider vinegar

The acetic acid in apple cider vinegar reduces certain enzymes in the stomach. One study reported that apple cider vinegar can improve insulin sensitivity after meals.

Try drinking 20 grams of apple cider vinegar in 40 grams of water before you

eat to help reduce a spike in blood sugar.

Leafy greens like spinach, kale, and chard

Kale is high in a number of nutrients, and can be added to a range of dishes.

Leafy greens are high in fiber and nutrients like magnesium and vitamin A. These nutrients can help to lower blood sugar. Leafy greens to add to your diet include:

• spinach

• lettuce

• collards

• turnip greens

• kale

• Swiss chard

Eating 1.35 servings instead of .2 servings of leafy greens per day is associated with a 14 percent reduction of risk for developing type 2 diabetes.

All leafy greens have a low GI. Spinach even has a GI ranking of less than 1 per 1 cup. Kale has an estimated GI score between 2 and 4. To add more leafy greens into your diet try this diabetes-friendly smoothie by Tracy Russell of Incredible Smoothies.

Chia seeds

Chia seeds are beneficial and high in fiber and healthy fats, omega-3s, calcium, and antioxidants. Studies have shown that high chia seed diets can help lower LDL cholesterol and triglycerides.

Chia seeds have a GI of 1 and are a great addition to recipes. The gooey texture works great as thickener in this pudding recipe from Little Broken (skip the maple syrup). Nutrition Stripped uses chia seeds and cauliflower to

make a low-carb pizza crust.

Cacao

Cacao is the base for chocolatey spreads and treats like cocoa butter and chocolate. Before confectioners add sugar, it’s bitter and unsweetened, like dark chocolate.

Cacao seeds are high in antioxidants. They also contain a flavanol called epicatechin, which regulates glucose production by activing key proteins. It can help to stabilize blood sugar, even in those who already have diabetes.

Swap out the milk chocolate for dark chocolate that contains 70 percent or more cacao. You can also use cacao nibs as toppings for your yogurt, smoothies, or desserts.

Blueberries and blackberries

Blackberries and blueberries won’t raise your blood sugar levels as much as other fruits. These berries are high in fiber and have the highest concentrations of anthocyanins. Anthocyanins inhibit

certain digestive enzymes to slow down digestion. They also prevent spikes in blood sugar after eating starch-rich meals.

reported adding blueberry bioactive (22.5 g) to smoothies improved insulin sensitivity in insulin resistance. The glycemic load of blueberries is 5. Satisfy your sweet tooth with this blueberry peach chia seed parfait.

Almonds and other nuts

Almonds are not the only nuts that may help to manage blood glucose levels, though they have the lowest GI score.

Almonds can help regulate and reduce rises in blood sugar after meals and

prevent diabetes. One study found people who consumed 2 ounces of almonds

per day had lower levels of fasting glucose and insulin. Another study found that almond consumption could increase insulin sensitivity in people with prediabetes.

The GI score for almonds is estimated to be 0. This is because small amounts of carbohydrate found in almonds and other nuts is primarily fiber. Toast almonds with cumin to create a healthy snack, or EatingWell's Chinese chicken noodle salad. For the noodle salad you may want to try kelp (seaweed) or shirataki (yam) noodles, which have low to no carbs.

Most nuts all have low GI scores, between 0 and 20. The nut with a higher GI score is the cashew (22). Opt for nuts like pistachios, walnuts, and macadamias instead of crackers and other snacks the next time you're hungry.

Whole grains

When shopping or eating out, opt for whole grains (like millet or quinoa) instead of "white grains." White grains are high in carbohydrates and can cause spikes. Whole grains have higher amounts of fiber, phytochemicals, and nutrients, and can help to regulate blood sugar.

One study found that whole grain consumption benefited insulin sensitivity. Fasting insulin rates were 10 percent lower after consumption. Whole-grain bread has a GI score of 51, and whole-grain pasta has a GI score of 42.

Eggs

Eggs are one of those foods that got a bad name because they contain a higher amount of cholesterol. But eating eggs doesn't seem to hurt those with prediabetes. It's also believed that dietary cholesterol isn't as important, at least for those who don't have type 2 diabetes.

Like all pure protein sources, eggs have a GI score of 0. Eggs can also

increase fullness and reduce cravings. But what you add to eggs can counteract their health benefits. It's best to consume eggs moderately, but hardboiled eggs may work as a satisfying snack or q uick breakfast.

Coffee

There's a study suggesting that increasing your coffee (caffeinated and decaffeinated) intake by one cup a day may lower your risk of type 2 diabetes by more than 10 percent. But what you add to the coffee matters too. Avoid adding too much sugar, syrups, and milk to your coffee.

CHAPTER 2

What nutrient can be converted into glucose?

ALL of them… all three macronutrients provide the needed core component of glucose - CARBON. One molecule of Glucose is comprised of 6 molecules of Carbon (C x 6 = C6) plus 6 molecules of water (6 x H2O = H12O6), or C6H12O6. This is ALSO the definition of "carbohydrate" - which means, literally, "hydrated carbon", or watered carbon. So carbs are the primary source of glucose - because they're comprised of carbon and water, so all our digestive systems have to do is break them down and "rearrange" them into the basic grouping for glucose. BUT… proteins and fats ALSO contain plenty of carbon, hydrogen and oxygen… especially with fluids consumed while eating. If no carbs are present, your body can make all the glucose it needs from the proteins and fats you eat - even though it's

“harder” to do.

Carbs, proteins, and fats are ALL the macronutrients there are; while the chemistry behind breaking them down is more complicated… it’s all on “auto-pilot” with respect to your digestive system. The more complex responses to your q uery have to do with converting glycogen - which is created by your system FROM the glucose it derives from the macronutrients you eat - back into glucose.

In basic order of occurrence, your body creates glucose from the foods you eat - carbs first and most of all, but proteins and fats as well; then, if the glucose isn’t immediately used/needed for current activity (physical motion, heartbeat, breathing, brain function, vision, and so on) it is stored as glycogen - a slightly denser form of the same basic components; it’s stored in the liver (your liver can hold about 10% of its own weight-worth of glycogen) and the long muscles (which can store about 2% of their own weight-worth of glycogen). The liver can release the glycogen as glucose into your bloodstream whenever your blood glucose is dropping; the long muscles simply use the glycogen themselves when they’re active.

If glycogen stores in the liver and long muscles are at maximum, and there’s still more glucose than needed in the bloodstream - it is stored as fat tissue, which is your body’s “long-term storage” reserve; it is accessed when you are in a state of ketosis - such as when you’re starving. This was part of our evolutionary development, a function developed to keep us alive during lean times, by storing excess fuel during bountiful times. Because we no longer suffer famines… we no longer ever “get around” to using the fat stores. But that’s what they’re there for!

LIST OF GLUCOSE RICH FOODS

Glucose is a simple carbohydrate, which eventually ensures almost 70 percent of the energy that organisms need. Besides, it is re q uired for the synthesis of proteins, nucleic acids and fats. In other words, glucose is an essential and vital substance for our organisms. If there is not enough glucose in the blood – hypoglycemia, we feel hunger, general weakness, sleepiness,

dizziness, we are confused etc. But we have to remember about the dark side of the coin, in particular, the excessive consumption of glucose may lead to the hyperglycemia, which increase the risk of obesity, diabetes mellitus type 2, cardiovascular diseases and oncology.

It’s important to mention that this article explores foods high in free glucose, while some people are actually looking for foods high in starch while searching for foods high in glucose.

For foods high in starch check out our Foods High in Starch page.

Foods high in starch and oligosaccharides such as lactose are transformed into the glucose since they consist of glucose and other single sugar items like galactose. Corn, rice and potatoes are high in starch. Dairy products such as yogurt, butter and milk are high in lactose. Thus, a small amount of free glucose does not exclude the chance of hyperglycemia.

1.Honey

Honey is high calorie product, rich in carbohydrates, considered to be a natural sugar substitute. The main carbohydrates are glucose and fructose, which proportion varies depends on the honey type. There are practically no fats and proteins in honey, and vitamin and mineral contents are minimal. Honey has been used as a powerful antibacterial, anti-imflammatory, immunomodulating, regenerating and analgesic agent since the ancient times. However, that applies only to the natural honey. It’s worth mentioning, that honey may become a strong allergen.

higher than 100% of foods

Honey is also rich in Carbs, Sugars and Calories

97% Carbs

79% Sugars

71% Calories

2.Dried fruit

Dried fruits are also high in sugars and calories. The percentage of carbohydrates depends on the fruit type, drying type, and additional sugar amount. Dried fruits are a gold mine of vitamins and minerals, especially Vitamin A and Potassium, which protect our eyesight and contribute to the right work of the heart respectively. They are also high in fiber, which helps digestion. The valuables are the dried fruits without sugar adding.

higher than 99% of foods

Dried fruit is also rich in Potassium, Vitamin A and Fiber

93% Potassium

89% Vitamin A

86% Fiber

3.Raisin

Raisins are kind of dried fruits, obtained by drying grapes, consists of much more valuable substances, than fresh ones. It is the source of glucose and fructose – q uick calories, which makes it popular among the sportsmen to quick recovering the energy. It is also high in vitamins, minerals and fiber.

higher than 98% of foods

Raisin is also rich in Carbs, Potassium and Sugars

95% Carbs

92% Potassium

78% Sugars

4.Prune

Prune is another type on dried fruits. It is high in glucose and fructose too. Prune is high in vitamins and minerals, especially high in Potassium and Vitamin K, each of them has an essential role for cardiovascular system. Prune is used as a laxative owing to the high amount of fiber.

higher than 98% of foods

Prune is also rich in Potassium, Fiber and Carbs

92% Potassium

86% Fiber

86% Carbs

5.Dates

Date palm is a q uite calorie food. Ancient sages and Arabian warriors ate only them during a long period of time. They are further very high in fiber, vitamins and minerals, and widely used in a dietology.

higher than 97% of foods

Dates is also rich in Carbs, Potassium and Fiber

93% Carbs

91% Potassium

87% Fiber

6.Barbecue sauce

The barbecue souse contains free glucose, is a middle calorie food. We should warn you about the high content of Sodium in the souse.

higher than 96% of foods

Barbecue sauce is also rich in Sodium, Ash and Carbs

95% Sodium

84% Ash

76% Carbs

7.Agave nectar

Agava nectar, these days is considered to be a natural sugar substitute, and is very popular among the supporters of the healthy nutrition. Nevertheless, it is not that simple, despite the low glycemic index, agava nectar may be harmful. It contains huge amount of fructose, and the abuse may lead to the resistance of insulin, metabolic disorders, diabetes mellitus type 2, and cardiovascular diseases. There are hardly any minerals in agava nectar, but it is rich in vitamins, particularly in Vitamin C.

higher than 96% of foods

Agave nectar is also rich in Carbs, Vitamin C and Sugars

94% Carbs

80% Vitamin C

78% Sugars

8.Jackfruit

Jackfruit is also rich in free glucose, vitamins, especially Vitamins C and B6. From the viewpoint of minerals jackfruit rich in Potassium and Calcium.

higher than 94% of foods

Jackfruit is also rich in Potassium, Vitamin C and Carbs

86% Potassium

78% Vitamin C

69% Carbs

9.Balsamic vinegar

Balsamic vinegar contains less glucose, than other foods in our list. Vitamins are practically missing here, and the mineral content is modest.

higher than 93% of foods

Balsamic vinegar is also rich in Water, Sugars and Carbs

74% Water

65% Sugars

62% Carbs

10.Banana

The proportion of sugars as well as the glycemic index of bananas depends on the stage of ripeness, so diabetics should avoid of ripped ones. Bananas high in Potassium, which is essential to the right function of heart.

higher than 92% of foods

Banana is also rich in Potassium, Vitamin C and Water

76% Potassium

75% Vitamin C

71% Water

11.Grape

Different types of grapes contain various amount of glucose, we give the average. Anyway, there is less glucose in a fresh fruit, than in raisins. Vitamin K is the only substance, which high in fresh fruit.

higher than 91% of foods

Grape is also rich in Water, Vitamin C and Sugars

79% Water

69% Vitamin C

66% Sugars

12.Common plum

Common plums include less sugars, vitamins and minerals due to the high q uantity of containing water. It should be emphasized that fresh plums contain more Vitamin C, than dried ones.

higher than 90% of foods

Common plum is also rich in Water, Vitamin C and Vitamin A

87% Water

75% Vitamin C

72% Vitamin A

13.Red Bull Energy Drink

Energetic Red Bull is a famous source of glucose. It is worth highlighting the high levels of Vitamins B. It contains caffeine as much as in a cup of coffee. Taurine and alpine water are the special components of Red Bull.

higher than 89% of foods

Red Bull Energy Drink is also rich in Water, Vitamin B6 and Vitamin B3

91% Water

89% Vitamin B6

88% Vitamin B3

14.Maize

Glucose is often called corn sugar because it is commonly commercially manufactured from cornstarch. It is relatively rich in free glucose. It is good source of Phosphorus and Zink as well as the vitamins B.

higher than 89% of foods

Maize is also rich in Magnesium, Water and Vitamin C

73% Magnesium

73% Water

73% Vitamin C

15.Smoothie

Smoothie also contains glucose, but the absolute value isn’t high enough because of the main component is water. Smoothie is in high in vitamin C, as well as in Vitamin A.

higher than 89% of foods

Smoothie is also rich in Water, Vitamin C and Vitamin A

92% Water

83% Vitamin C

74% Vitamin A

Sucrose vs Glucose vs Fructose: What's the Difference?

If you’re trying to cut back on sugar, you may wonder whether the type of sugar matters.

Sucrose, glucose and fructose are three types of sugar that contain the same number of calories gram for gram.

They’re all found naturally in fruits, vegetables, dairy products and grains but also added to many processed foods.

However, they differ in their chemical structures, the way your body digests and metabolizes them and how they affect your health.

This article examines the main differences between sucrose, glucose and

fructose and why they matter.

Sucrose Is Made up of Glucose and Fructose

Sucrose is the scientific name for table sugar.

Sugars are categorized as monosaccharides or disaccharides.

Disaccharides are made up of two, linked monosaccharides and broken back down into the latter during digestion.

Sucrose is a disaccharide consisting of one glucose and one fructose molecule, or 50% glucose and 50% fructose.

It's a naturally occurring carbohydrate found in many fruits, vegetables and grains, but it's also added to many processed foods, such as candy, ice cream, breakfast cereals, canned foods, soda and other sweetened beverages.

Table sugar and the sucrose found in processed foods are commonly extracted from sugar cane or sugar beets.

Sucrose tastes less sweet than fructose but sweeter than.

Glucose

Glucose is a simple sugar or monosaccharide. It's your body's preferred carb-based energy.

Monosaccharides are made up of one single unit of sugar and thus cannot be broken down into simpler compounds.

They're the building blocks of carbohydrates.

In foods, glucose is most commonly bound to another simple sugar to form either polysaccharide starches or disaccharides, such as sucrose and lactose.

It's often added to processed foods in the form of dextrose, which is extracted from cornstarch.

Glucose is less sweet than fructose and sucrose.

Fructose

Fructose, or “fruit sugar,” is a monosaccharide like glucose.

It’s naturally found in fruit, honey, agave and most root vegetables. Moreover, it’s commonly added to processed foods in the form of high-fructose corn syrup.

Fructose is sourced from sugar cane, sugar beets and corn. High-fructose corn syrup is made from cornstarch and contains more fructose than glucose, compared to regular corn syrup.

Of the three sugars, fructose has the sweetest taste but least impact on your blood sugar

They’re Digested and Absorbed Differently

Your body digests and absorbs monosaccharides and disaccharides differently.

Since monosaccharides are already in their simplest form, they don’t need to be broken down before your body can use them. They’re absorbed directly into your bloodstream, primarily in your small intestine

On the other hand, disaccharides like sucrose must be broken down into simple sugars before they can be absorbed.

Once the sugars are in their simplest form, they’re metabolized differently.

Glucose Absorption and Use

Glucose is absorbed directly across the lining of the small intestine into your bloodstream, which delivers it to your cells.

It raises blood sugar more quickly than other sugars, which stimulates the release of insulin.

Insulin is needed for glucose to enter your cells.

Once inside your cells, glucose is either used immediately to create energy or turned into glycogen to be stored in your muscles or liver for future use.

Your body tightly controls your blood sugar levels. When they get too low, glycogen is broken down into glucose and released into your blood to be used for energy.

If glucose is unavailable, your liver can make this type of sugar from other fuel sources.

Fructose Absorption and Use

Like glucose, fructose is absorbed directly into your bloodstream from the small intestine.

It raises blood sugar levels more gradually than glucose and does not appear to immediately impact insulin levels.

However, even though fructose doesn’t raise your blood sugar right away, it may have more long-term negative effects.

Your liver has to convert fructose into glucose before your body can use it for energy.

Eating large amounts of fructose on a high-calorie diet can raise blood triglyceride levels.

Excessive fructose intake may also raise the risk of metabolic syndrome and non-alcoholic fatty liver disease.

Sucrose Absorption and Use

Since sucrose is a disaccharide, it must be broken down before your body can use it.

Enzymes in your mouth partially break down sucrose into glucose and fructose. However, the majority of sugar digestion happens in the small intestine.

The enzyme sucrase, which is made by the lining of your small intestine, splits sucrose into glucose and fructose. They are then absorbed into your bloodstream as described above.

The presence of glucose increases the amount of fructose that is absorbed and also stimulates the release of insulin. This means that more fructose is used to create fat, compared to when this type of sugar is eaten alone.

Therefore, eating fructose and glucose together may harm your health more than eating them separately. This may explain why added sugars like high-fructose corn syrup are linked to various health issues.

Foods Containing High Levels of Glucose

Glucose is a sugar made of a single sugar unit that is ubi q uitous in the food supply and a key player in human and plant metabolism. In human metabolism, glucose is responsible for providing energy. Although it's necessary to support human life, too much glucose in the diet has been associated with health complications such as obesity, diabetes, cardiovascular disease and cancer. Following dietary guidelines to ensure that sugar intakes are within a healthy range is a good way to avoid these problems. Individuals with diabetes need to be particularly careful about how much glucose and other sugars they consume.

Natural High

Glucose is a byproduct of the process of photosynthesis that plants undergo to provide themselves with energy. As a result, many plants, particularly fruits, are high in glucose. Examples of fruits high in glucose include bananas, grapes, kiwi, cherries and persimmons. Dried fruits are particularly high in glucose because of their low water content. According to the United States Department of Agriculture Nutrient Database, Medjool dates have the highest glucose content among dried fruits. The most potent source of

glucose is honey, with a higher glucose content than any other sweetener, with the exception of artificially manufactured glucose.

Foods Digested as Glucose

Foods high in starch and smaller sugars such as lactose are eventually digested to generate glucose. This is because they are composed of glucose and other single sugar units like galactose that are connected by special bonds, rather than free glucose, which is unbound. Foods high in starch include corn, rice and potatoes. Foods high in lactose include most dairy products such as milk, butter and yogurt. Just because these foods are not high in free glucose doesn't mean that they won't raise blood sugar.

Glucose Supplements and Added Sugars

Glucose supplements are not commonly used, with the exception of high-performance athletes who use them to maintain energy during long endurance activity. Many foods have added sugars, including glucose, such as soft drinks, cereal, granola bars and commercial baked goods. The American Heart Association suggests that you consume no more than 100 calories per day from added sugars, so you should avoid these types of foods.

Dietary Recommendations

No specific guidelines exist for glucose intake for healthy individuals, so follow the guidelines for overall carbohydrate intake suggested by the Institute of Medicine. The current recommendations are to consume between 45 and 65 percent of your daily total calories from carbohydrates, emphasizing fruits, vegetables and whole grains, and minimizing added sugars.

Dietary Protein and the Blood Glucose Concentration

Body proteins are being synthesized and degraded continuously.The estimated turnover is ~ 210 g/day. Amino acids resulting from protein degradation can be recycled (reused for synthesis), but this is incomplete. Therefore, dietary protein is necessary for maintenance of lean body mass. Also, dietary protein is required to replace protein lost from the shedding of skin, hair, nails, cells in the gastrointestinal tract, and protein-containing secretions. However, the actual losses are estimated to be only 6–8 g/day.

Overall, approximately ~ 32–46 g of high- q uality dietary protein/day is reported to be required to maintain protein balance.This is considerably less than amounts of protein reportedly consumed by American adults (~ 65–100+ g/day).The excess food-derived amino acids then are oxidized as fuel directly or indirectly after conversion to glucose.

In 1915, using a phlorhizinized dog preparation, Janney demonstrated clearly that the deaminated amino acids (carbon skeletons) present in dietary proteins could be used to produce glucose endogenously. For most common proteins, 50–80 g of glucose can be derived from 100 g of ingested protein. Nevertheless, as early as 1913, Jacobson reported that ingestion of proteins did not raise the blood glucose.

Later, in 1924, MacLean fed 50 g of meat protein to two subjects, one with and one without mild diabetes. The theoretical amount of glucose that could be produced was 25 g. However, there was no change in blood glucose. He then fed the subjects 25 g glucose and the blood glucose was clearly elevated. In 1936, Conn and Newburgh reported that ingestion of even a very large amount of protein as meat (1.3 pounds, 0.59 kg), did not raise the blood glucose.

Subse q uently, the degradation pathways for each amino acid were elucidated. Of the 20 amino acids found in proteins, all but leucine could, at least in part, be converted into glucose and thus contribute to the circulating glucose pool. However, data from many laboratories, including our own, confirmed that ingested protein per se does not increase the circulating glucose concentration.The reason for this remained unknown.

In order to address this issue, a number of years ago we determined the actual amount of glucose entering the circulating glucose pool using a glucose isotope-dilution techni q ue. Urea formation was determined as an index of

the amount of ingested protein deaminated, and the carbon skeletons available for glucose synthesis. Normal, young subjects ingested 50 g of cottage cheese protein (casein). It was calculated that 34 g were deaminated (68%) over the 8 h of the study. The amount of glucose produced and entering the circulation was only 9.7 g.Thus, the amount of glucose produced was considerably less than the amount theorized (~ 25 g). The plasma glucose concentration did not change.

Later, in people with untreated type 2 diabetes, ingestion of 50 g beef protein was calculated to result in only 2.0 g of additional glucose added to the circulation over the 8-h study period. These results were rather surprising because, as expected, the basal glucose production rate in the diabetic subjects was greater than that in normal young subjects.Interestingly, numerous studies now have demonstrated that provision of any of the commonly ingested gluconeogenic substrates, fructose, galactose, glycerol, as well as amino acids, when infused or ingested do not, or only modestly, increase hepatic production and release of glucose and have little effect on the circulating glucose concentration. This is due to a hepatic autoregulatory process which is independent of a change in the circulating insulin or glucagon concentrations.

In this issue of Diabetes, Fromentin et al. have elegantly addressed the issue of the endogenous partitioning of the absorbed amino acids derived from a food (egg) protein. They specifically address the disposition of the carbon skeletons derived from the total amino acids and the appearance rate and q uantity of glucose entering the plasma pool over an 8-h period using multitracer technology.

Their study is uni q ue in four ways: First, whole eggs were used as a source of protein, i.e., a modest amount of fat as well as protein was ingested. Second, the amount of protein ingested (23 g) was lower than others had used and is well within an amount likely to be ingested in a single meal. Third, diet-derived carbon and nitrogen stable-isotope tracers were used. Thus, both the fate of the amino moiety as well as the amino acid carbon chains were traced. This labeling was accomplished by adding doubly labeled amino acids to the diet of laying hens. Fourth, subjects were encouraged to ingest a defined diet containing 14% protein for 5 days prior to the study.

The authors calculated that ~ 18 g (79%) of the 23 g of ingested protein

could be accounted for by deamination; thus those carbon skeletons were available for gluconeogenesis and release of new glucose into the circulation. The remainder, presumably, was used for new protein synthesis.

The total amount of glucose entering the circulation from all sources was calculated to be 50 g over the 8-h period. However, only 4 g (8%) could be attributed to the ingested protein. This was less than a theoretical maximum, but as the authors point out, the fractional conversion was the same as we determined previously following casein ingestion. This suggests a highly regulated process. The remaining deaminated amino acid carbon appeared as CO2, i.e., was oxidized as fuel directly.

The data are compelling but need to be interpreted in the context of a lack of a randomized, crossover, 8-h fasting control group. Also the subjects were in negative nitrogen balance (31 g protein oxidized/23 g ingested). Additional studies using larger amounts of protein in subjects either adapted to or not adapted to a high protein diet (~ 30% of food energy) would be of interest.

Overall, these data clearly indicate that endogenous production and addition of glucose to the circulation from dietary protein are relatively small. The regulatory mechanisms that control the partitioning of the fate of food-derived amino acids between new protein synthesis, deamination, direct oxidation as fuel or conversion into glucose and glucose release into the circulation remain to be determined.

Conclusion

Diabetes is a slow killer with no known curable treatments. However, its complications can be reduced through proper awareness and timely treatment. Three major complications are related to blindness, kidney damage and heart attack. It is important to keep the blood glucose levels of patients under strict control for avoiding the complications. One of the difficulties with tight control of glucose levels in the blood is that such attempts may lead to hypoglycemia that creates much severe complications than an increased level of blood glucose. Researchers now look for alternative methods for diabetes treatment. The goal of this paper is to give a general idea of the current status

of diabetes research. The author believes that diabetes is one of the highly demanding research topics of the new century and wants to encourage new researchers to take up the challenges. eamination, direct oxidation as fuel or conversion into glucose and glucose release into the circulation remain to be determined.