

Carbohydrates, Sugars, and the Glycemic Index



The term “carbohydrates” includes simple sugars (monosaccharides) and complex carbohydrates (polysaccharides), which include starch and fiber. The term “monosaccharide” means it has one sugar molecule and the term “polysaccharide” means it has many sugar molecules.

Simple sugars and complex carbohydrates occur naturally in many foods including fruits, breads, vegetables, milk, cereals, legumes (beans) and grains. Fructose is a sugar found naturally in fruit. In addition to sugar, fruit also provides vitamins, minerals, fiber and antioxidants. Lactose is a sugar found naturally in milk products. In addition to sugar, milk products also provide protein, potassium and calcium.

Sugars are also added to foods during processing. On a food label various names for sugars can be found: *brown sugar, corn sweetener, corn syrup, fruit juice concentrate, glucose (dextrose), high-fructose corn syrup, honey, invert sugar, maltose, molasses, raw sugar, sucrose and brown rice syrup*. These sugars give us mainly calories with little, if any, added nutrients. Bakery items, candies, and soft drinks are examples of foods that provide sugar and calories with few nutrients.

Sugars listed on the Nutrition Facts label include *both* naturally occurring sugars, like fructose found in fruit and lactose in milk, as well as added sugars such as those shown in italics above.

Sugars are used for flavor enhancement, to improve food texture, as a baking aid and as a preservative. But too much sugar can cause major health problems.

Eating a diet high in sugar makes maintaining a healthy weight and nutritional balance more difficult. A diet high in sugar also raises blood sugar very quickly, causing it to spike rapidly. At first we get a surge of energy, but as blood sugar levels rise, special cells in the pancreas churn out more and more insulin, a hormone that signals cells to absorb blood sugar. The surge of insulin quickly moves the glucose out of the bloodstream and into our cells, but the consequent drop in blood sugar triggers feelings of hunger and the process starts all over again. In some people this cycle doesn't work properly. People with diabetes either don't produce enough insulin so their cells can't absorb sugar, or their cells *don't respond* to insulin and it cannot do its job of getting sugar into the cells. Up to 20% of the population has ‘pre-diabetes’, or insulin resistance, of which approximately one in four will ultimately develop type II diabetes.

Insulin resistance isn't just a blood sugar problem. It has also been linked to a variety of other problems:

- ✓ High blood pressure
- ✓ High levels of triglycerides
- ✓ Low HDL (the “good” cholesterol)
- ✓ Heart disease
- ✓ Possibly some cancers

Genes, a sedentary lifestyle, being overweight and eating a diet high in sugar can all promote insulin resistance. It is also a major factor in “Metabolic Syndrome”.

The Glycemic Index

The Glycemic Index (GI) was developed originally to help people with diabetes manage their food intake. It's a measure of how rapidly carbohydrates are digested. The GI assigns a number based on the extent to which a given food causes blood glucose, or "blood sugar" to rise. Foods with a high GI rating contain carbohydrates that cause a dramatic rise in blood-glucose levels, while those with a low number contain carbohydrates with much less impact. White bread, white pasta, and cake all have high GI numbers, while whole-wheat bread, chickpeas and apples all have low GI numbers.

Weight Control

Jennie Brand-Miller (PhD) and colleagues collect the latest information in *The New Glucose Revolution* (Marlow & Company, 2003). "The glycemic index can play an important role in weight control by helping control appetite and insulin levels," Brand-Miller and her co-authors write. Low glycemic foods fill you up and keep you satisfied longer. They also moderate insulin response, which helps you burn more fat and less muscle.

Brand-Miller and her colleagues say several mechanisms are at work. Low GI foods, such as apricots and black beans, remain in the small intestine longer, "triggering receptors that tell the brain there's food still in the gut to be digested." On the other hand, high GI foods, like papaya and white bread, are digested readily causing a "rapid rise and then fall" in blood sugar, triggering a hunger signal to the brain.

"Stress hormones like adrenalin and cortisol are released when glucose levels spike after eating high GI foods" say the authors. "Both hormones tend to stimulate appetite."

Finally, low-GI foods may be more satisfying "simply because they are often less energy dense than their high-GI counterparts," the authors write. "The naturally high fiber content of many low-GI foods" takes up more room "without increasing their energy content." In short, foods with low GI values frequently have low energy density (calories) as well.

Insulin Response

What's more, low-GI foods, such as lentils, pasta, oatmeal and corn, result in lower levels of insulin than high-GI foods (boiled potatoes and instant rice). This is important to weight watchers, the authors explain, because "high levels of insulin mean the body is *forced* to burn carbohydrates rather than fat." Even if total calories are the same, low-GI foods result in more fat burn.

Obese individuals tend to be sugar burners. Carbohydrate or sugar (glycogen) stored in their muscles and liver is their major source of fuel. Fat in food they eat and fat deposits are untouched. "The next meal restores glycogen to its former level (especially if the food has a high GI value) and the cycle repeats itself," the authors write. Their fat stores remain intact and usually grow larger.

Obviously, it would be helpful to people trying to control their weight to know the GI value of various foods. Unfortunately, that's easier said than done.

Some Surprises

To determine GI value, the amount of food containing a standard amount of carbohydrate (usually 25 or 50 grams) must be fed to real people, blood drawn over 2 or 3 hours, and the glucose measured in a laboratory. Surprises -- and confusion -- are not unusual.

Early reports gave table sugar a value of 100 and used it as a reference point, with the thought that it's pure glucose and is rapidly absorbed. That was a logical assumption, but it's incorrect. Sugar (sucrose) is actually half glucose and half fructose. After being absorbed, fructose is taken directly to the liver for immediate oxidation (burning for energy); its GI value is actually very low, at 19. The actual GI rating of table sugar is the average of glucose and fructose, or 60. Glucose is, in fact, the standard, with a GI of 100.



The GI value of carrots was originally reported to be 92. People were excluding carrots from their diet, because of the high GI score. Turns out, that was a mistake. Only five people were used in the first study and, according to Brand-Miller and her co-authors, the variation among them was “huge.” “When carrots were assessed more recently,” the authors write, “ten people were included, the reference food was tested twice, and a mean value of 32 was obtained with narrow variation.”

But the comprehensive tables in the back of the book give four different values for carrots, ranging from 16 to 92. The condensed tables give a value of 49 for peeled, boiled carrots. Makes you wonder, doesn't it?

Glycemic Load

A major criticism of the glycemic index is that it doesn't predict the effect of a normal serving of food. That's because foods contain different amounts of carbohydrate, while the GI is a comparison of the same amount of carbohydrate. To solve that problem, researchers at Harvard University came up with a companion value called “Glycemic Load.”

Glycemic load attempts to predict the blood glucose response to foods containing carbohydrate, rather than the carbohydrate alone. The glycemic load is calculated by multiplying the GI value of a food by the amount of carbohydrate per serving and dividing by 100. For example, an apple has a GI value of 40. One serving, however, contains only 15 grams of carbohydrate, making the glycemic load only 6 (40 x 15 divided by 100). A potato has a GI value of 90 and 20 grams of carbohydrate per serving. Therefore, it has a glycemic load of only 18 (90 x 20 divided by 100).



A related complaint is that carbs are usually consumed as part of a meal, rather than an individual food. The authors also give a multi-step formula for calculating the GI value of a total meal. “Many studies have shown a very close relationship between the predicted blood-glucose response (based on published GI values of the relative effects of different foods and meals) and the actual observed blood-glucose response,” they write.

Hunger Complex

Some experts say the glycemic index is becoming too complicated to be of much value to most people. “[Hunger is] not that simple,” Kathleen Zellman, RD, a spokesperson for the American Dietetics Association. “It's also affected by meal size, whether there's any fat in the meal, and overall health status.”

Susan Roberts, PhD, of the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University adds: “The best research indicates that [the] glycemic index is probably only one of several factors that influence how hungry and satisfied we are.” Her suggestion: Think high protein, high fiber, low calorie,

and low glycemic index when looking for a hunger-satisfying food. “If you can focus on a variety of foods with these properties you will certainly feel more satisfied and less hungry than if you eat a highly refined, low-fiber, high-fat diet,” she says.



Remember Concept, Forget Index

The concept of the glycemic index is helpful. Keep in mind that refined carbohydrate foods leave you hungry and make you gain weight. But no one wants to carry glycemic tables around in their pocket or purse. I certainly don't. It's not necessary.

The bottom line: Whenever possible, replace highly processed grains, cereals, and sugars with minimally processed whole-grain products. Build your meals around high fiber, unrefined, whole foods – vegetables, fruits, low-fat dairy products, legumes and whole grains -- and add some lean protein and good fat. You'll be fine.



Healthy Choices to Lower Sugar

- ✓ Don't cut out foods such as low-fat dairy products, fruits and vegetables that naturally contain sugar. The body needs nutrients found in these foods. A better place to start cutting sugar from the diet is from foods that contain large amounts of added sugar, but are not sources of other nutrients.
- ✓ Ready-to-eat cereals vary in sugar content. Read the Nutrition Facts Panel to compare the sugar content, and try to keep this number under 6 for cereals. The grams of sugar per serving reflects both sugar added by the manufacturer and naturally occurring sugar.
- ✓ There are 4 grams of sugar in one teaspoon. A 12-oz can of Coca-cola has 40 grams of sugar, so that means there are 10 teaspoons of sugar in one can.
- ✓ Add fresh fruit to plain, ready-to-eat cereals instead of sugar. Or try sugar substitutes like Splenda.
- ✓ Gradually decrease sugar in recipes by one-quarter to one-third the amount called for in baked items. Bring out the sweetness with vanilla, lemon or almond extract. Splenda can be used in baking as well.
- ✓ Use fresh fruit toppings or unsweetened applesauce for pancakes, waffles, and French toast instead of syrup or honey.
- ✓ Choose yogurts, frozen dairy desserts and ice milks with fruit or non-caloric sweeteners like Splenda.
- ✓ Eliminate consumption of soft drinks containing sugar. Instead choose unsweetened tea (add your own no-calorie sweetener), low-fat milk, mineral water with a splash of fruit juice or club soda with a slice of fresh lemon or lime.
- ✓ Substitute raw vegetables, fresh fruit or 3 cups of low-fat popcorn for sweet snacks. Prepare them ahead of time so they are ready when you are.
- ✓ Try making your own salad dressing. Many commercial dressings contain a large amount of sugar.
- ✓ Read labels on bottled sauces and packaged seasoning mixes. You can easily make a similar version at home without the added sugar.