

Using the glycemic index to compare carbohydrates

Carbohydrates are often divided into two categories—simple and complex. Simple carbohydrates include mono- and disaccharides (i.e. fruit sugars and table sugars) and tend to be absorbed faster than complex carbohydrates or polysaccharides (i.e. breads, pasta, grains). However, due to the varying rates of digestion and absorption between different carbohydrates, such simple classifications may not always be the most useful.

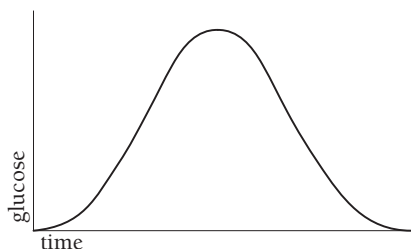
What is the glycemic index?

Foods are assigned glycemic index numbers based on the comparative increases in blood glucose (sugar) levels they produce when eaten. A low to moderate glycemic food causes a slow, gradual rise in blood sugar, and maintains the increased energy level for a longer duration. A high glycemic food increases the blood sugar concentrations quickly, thus providing energy to the body in a short period of time. However, insulin is released in response to this rise in blood sugar, which, in turn, brings the blood sugar down fairly rapidly. This rapid decrease reduces the energy supply and may trigger hunger.

How is the glycemic index determined?

Specific procedures can vary with the researcher. In general, human subjects are fed 50 grams of carbohydrate from a specific food. The subjects' blood glucose levels

are measured at intervals over the following 2 hours to monitor the blood glucose response.



By comparing the area under the graphed line with that obtained from consuming 50 grams of pure glucose, a percentage is determined. For example, a glycemic index of 60 indicates that consuming 50 grams of that food causes an increase in blood glucose 60 percent as great as that produced by eating 50 grams of pure glucose.

What factors influence the glycemic index of foods?

Many factors can influence the glycemic index. Often foods with different glycemic indexes are consumed simultaneously, which affects the glycemic index of the individual foods. In addition, other factors that can influence the glycemic index include:

- Biochemical structure of the carbohydrate—for example, amylopectin is more readily absorbed than amylose
- Intestinal absorption
- Food particle size—smaller particles are absorbed faster

Glossary

amylopectin—a component of starch that has a high molecular weight and branched structure and does not tend to gel in aqueous solutions

amylose—a component of starch characterized by its straight chains of glucose units and by the tendency of its aqueous solutions to set to a stiff gel

disaccharide—two chain molecules of sugars

epidemiological studies—medical science that deals with the incidence, distribution, and control of disease in a population

glycogen—the principal form in which carbohydrates are stored in the body

glucose—sugar

glycemic index—measurement based on the amount of increase in blood glucose levels after eating a specific food

lipid—another term for fat

monosaccharide—single chain molecules of sugars

polysaccharide—multiple chain molecules of sugars


- Mechanical and thermal processing—both break the food into smaller particles thus facilitating absorption
- Content and timing of the previous meal
- Accompanying foods that include fat, fiber, or protein—fat and protein decrease the speed with which the stomach empties, thus decreasing the rate of carbohydrate absorption, which reduces the rate of elevating blood glucose and produces a lower glycemic index.


Why is the glycemic index important?


People need the energy provided by food; they react to a lack of food by feeling hungry. Monitoring energy levels is especially important for athletes and people with health implications, such as diabetes mellitus. Due to the importance of balancing blood glucose levels in diabetics, low to moderate glycemic foods are recommended to moderate blood glucose in these individuals.


Athletes often choose foods that optimize their glycogen stores. Most athletes benefit the most from eating foods having a low to moderate glycemic index in their pre-game meal, and then eating high glycemic foods immediately after exercise. However, the post-activity meal also should contain low to moderate glycemic foods for optimal glycogen storage.

Proponents and critics debate both the merits of the glycemic index and how it is calculated.

 Clinical trials researching meals with different glycemic indexes confirm that eating low glycemic foods helps blood glucose levels stay more level and thus reduces the amount of insulin released after a meal. When blood glucose levels are fairly even between meals, fat is also metabolized at a healthier rate so blood lipid levels remain comparatively even.

 Monitoring the glycemic index for various foods is one way diabetics can try to control their blood glucose levels.

 Studies where dietary habits have been examined indicate that foods with higher glycemic indexes are a risk factor for diabetes, obesity, and cardiovascular disease. Groups consuming high glycemic foods were at greater risk of developing chronic disease than did the groups consuming foods with lower glycemic indexes.

 Critics have raised several concerns regarding how the glycemic index is calculated.


* Differences in glycemic indexes are falsely elevated when based only on a comparison of the differences in blood glucose elevation instead of on the entire change in blood glucose levels.


* The time used in many studies (2 hours) is too short. Monitoring blood glucose levels over a 4-hour

period would show fewer differences between foods.

* The type of dietary investigations on which the epidemiological studies base their arguments are not detailed enough to catch the many variations in the glycemic indexes. The glycemic index can vary with varieties within a food group, method of preparation, growing conditions, geographic locations, genetic strain, ripeness, acidity, fiber, protein, and fat content of foods.

* Many epidemiological studies show no effect of glycemic indexes.

 The glycemic index does not necessarily predict the insulin response, since it also is affected by other factors in food, such as the kind of protein and the protein content.

 Current research is investigating whether rapid fluctuations in blood glucose levels increase the risk of fat gain and type 2 diabetes.

For more information on other nutrition topics visit these Web sites:

Iowa State University
Extension nutrition—
www.extension.iastate.edu/nutrition

Iowa State University
Extension publications—
www.extension.iastate.edu/pubs

Glycemic Indexes of Common Foods

Breads & Grains

waffle - 76
doughnut - 76
bread, whole wheat – 73
bagel - 72
wheat bread, white - 70
cornmeal - 68
bran muffin - 60
rice, white - 56
rice, brown – 55
wheat kernels - 48
rice, instant (1 minute) - 46
bulgur - 46
spaghetti, white - 41
spaghetti, whole wheat - 32
barley - 25

Cereals

Rice Krispies® - 82
Grape Nuts Flakes® - 80
corn flakes - 77
Cheerios® - 74
shredded wheat - 67
Grape Nuts® 67
Life® - 66
All Bran® – 38

Fruits

watermelon - 72
pineapple - 66
raisins - 64
banana - 51
orange - 48
grapes - 43
apple - 40
pear - 33

Starchy Vegetables

carrots - 92
potatoes, instant - 88
potatoes, baked - 78
potatoes, mashed - 73
sweet potatoes - 48

Legumes

baked beans - 40
butter beans - 36
split peas - 32
lentils - 28
kidney beans - 23
soy beans - 15

Dairy

ice cream - 62
yogurt, low fat sweetened - 33
milk, skim - 32
milk, full fat - 21

Snacks

rice cakes - 82
jelly beans - 80
graham crackers - 74
life savers - 70
angel food cake - 67
wheat crackers - 67
potato chips - 57
popcorn - 55
oatmeal cookies - 54
banana cake - 47
chocolate - 44
corn chips - 42
peanuts - 13

Sugars

honey - 87
sucrose - 60
lactose - 43
fructose - 20

Beverages

soft drinks - 63
orange juice - 57
apple juice – 41

For additional glycemic indexes visit these Web sites:

[www.diabetesdigest.com/
dd_nutrition2.htm](http://www.diabetesdigest.com/dd_nutrition2.htm)

[www.diabetesnet.com/
diabetes_food_diet/
glycemic_index.php](http://www.diabetesnet.com/diabetes_food_diet/glycemic_index.php)

[www.mesquitemagic.com/
glycemic_Index_chart.htm](http://www.mesquitemagic.com/glycemic_Index_chart.htm)

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Foods are listed from highest to lowest glycemic index within category. Glycemic index was calculated using glucose as the reference with glycemic index of 100. (The University of Sidney, www.glycemicindex.com)

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