



Role of Various Nutrients on Glycemic Index of Food

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ABSTRACT : The glycemic index is a value assigned to foods based on how slowly or how quickly those foods cause increases in blood glucose levels. Foods low on the glycemic index (GI) scale tend to release glucose slowly and steadily. Foods high on the glycemic index release glucose rapidly. Low GI foods tend to foster weight loss, while foods high on the GI scale help with energy recovery after exercise, or to offset hypo- (or insufficient) glycemia. Long-distance runners would tend to favor foods high on the glycemic index, while people with pre- or full-blown diabetes would need to concentrate on low GI foods. Why? People with type 1 diabetes can't produce sufficient quantities of insulin and those with type 2 diabetes are resistant to insulin. With both types of diabetes, faster glucose release from high GI foods leads to spikes in blood sugar levels. The slow and steady release of glucose in low-glycemic foods helps maintain good glucose control. The low glycemic (low GI) diet is based on the concept of the glycemic index (GI). Studies have shown that the low GI diet may result in weight loss, reduce blood sugar levels, and lower the risk of heart disease and type 2 diabetes. However, the way it ranks foods has been criticized for being unreliable and failing to reflect foods' overall healthiness.

I. INTRODUCTION

Carbohydrates are found in breads, cereals, fruits, vegetables, and dairy products. They're an essential part of a healthy diet. When you eat any type of carb, your digestive system breaks it down into simple sugars that enter the bloodstream.

Not all carbs are the same, as different types have unique effects on blood sugar. The glycemic index (GI) is a measurement system that ranks foods according to their effect on your blood sugar levels. It was created in the early 1980s by Dr. David Jenkins, a Canadian professor (Trusted Source). The rates at which different foods raise blood sugar levels are ranked in comparison with the absorption of 50 grams of pure glucose. Pure glucose is used as a reference food and has a GI value of 100.[1]

The three GI ratings are:

Low: 55 or fewer

Medium: 56–69

High: 70 or more

Foods with a low GI value are the preferred choice. They're slowly digested and absorbed, causing a slower and smaller rise in blood sugar levels. On the other hand, foods with a high GI value should be limited. They're quickly digested and absorbed, resulting in a rapid rise and fall of blood sugar levels. You can use this database to find the GI value (and glycemic load, described below) of common foods. It's important to note that foods are only assigned a GI value if they contain carbs. Hence, foods without carbs won't be found on GI lists. Examples of these foods include: beef, chicken, fish, eggs, herbs, spices. A number of factors can influence the GI value of a food or meal, including:

The type of sugar it contains. There's a misconception that all sugars have a high GI. The GI of sugar ranges from as low as 23 for fructose to up to 105 for maltose. Therefore, the GI of a food partly depends on the type of sugar it contains.[2]

The structure of the starch. Starch is a carb comprising two molecules — amylose and amylopectin. Amylose is difficult to digest, whereas amylopectin is easily digested. Foods with a higher amylose content will have a lower GI (Trusted Source).

How refined the carb is. Processing methods such as grinding and rolling disrupt amylose and amylopectin molecules, raising the GI. Generally speaking, the more processed a food is, the higher its GI (Trusted Source).



Nutrient composition. Adding protein or fat to a meal can slow digestion and help reduce the glycemic response to a meal (3Trusted Source, 4Trusted Source).Cooking method. Preparation and cooking techniques can affect the GI too. Generally, the longer a food is cooked, the faster its sugars will be digested and absorbed, raising the GI.Ripeness. Unripe fruit contains complex carbs that break down into sugars as the fruit ripens. The riper the fruit, the higher its GI. For example, an unripe banana has a GI of 30, whereas an overripe banana has a GI of 48 (5Trusted Source).The rate at which foods raise blood sugar levels depends on three factors: the types of carbs they contain, their nutrient composition, and the amount you eat.However, the GI is a relative measure that doesn't take into account the amount of food eaten. It's often criticized for this reason (1Trusted Source).To solve this, the glycemic load (GL) rating was developed.

The GL is a measure of how a carb affects blood sugar levels, taking both the type (GI) and quantity (grams per serving) into account.[3]

Like the GI, the GL has three classifications:

Low: 10 or fewer

Medium: 11–19

High: 20 or more

The GI is still the most important factor to consider when following the low GI diet.

However, the Glycemic Index Foundation, an Australian nonprofit raising awareness about the low GI diet, recommends that people also monitor their GL and aim to keep their total daily GL under 100.Otherwise, the easiest way to aim for a GL under 100 is to choose low GI foods when possible and consume them in moderation.

II. DISCUSSION

A glycemic index diet is an eating plan based on how foods affect your blood sugar level.The glycemic index is a system of assigning a number to carbohydrate-containing foods according to how much each food increases blood sugar. The glycemic index itself is not a diet plan but one of various tools — such as calorie counting or carbohydrate counting — for guiding food choices.

The term "glycemic index diet" usually refers to a specific diet plan that uses the index as the primary or only guide for meal planning. Unlike some other plans, a glycemic index diet doesn't necessarily specify portion sizes or the optimal number of calories, carbohydrates, or fats for weight loss or weight maintenance.Many popular commercial diets, diet books and diet websites are based on the glycemic index, including the Zone Diet, Sugar Busters and the Slow -Carb Diet.

The purpose of a glycemic index (GI) diet is to eat carbohydrate-containing foods that are less likely to cause large increases in blood sugar levels. The diet could be a means to lose weight and prevent chronic diseases related to obesity such as diabetes and cardiovascular disease.A GI value tells us nothing about other nutritional information. For example, whole milk has a GI value of 31 and a GL value of 4 for a 1-cup (250-milliliter) serving. But because of its high fat content, whole milk is not the best choice for weight loss or weight control.The published GI database is not an exhaustive list of foods, but a list of those foods that have been studied. Many healthy foods with low GI values are not in the database.The GI value of any food item is affected by several factors, including how the food is prepared, how it is processed and what other foods are eaten at the same time.Also, there can be a range in GI values for the same foods, and some would argue it makes it an unreliable guide to determine food choices.[4]

A GI diet prescribes meals primarily of foods that have low values. Examples of foods with low, middle and high GI values include the following:

- Low GI: Green vegetables, most fruits, raw carrots, kidney beans, chickpeas, lentils and bran breakfast cereals
- Medium GI: Sweet corn, bananas, raw pineapple, raisins, oat breakfast cereals, and multigrain, oat bran or rye bread
- High GI: White rice, white bread and potatoes

Commercial GI diets may describe foods as having slow carbs or fast carbs. In general, foods with a low GI value are digested and absorbed relatively slowly, and those with high values are absorbed quickly.Commercial GI diets have varying recommendations for portion size, as well as protein and fat consumption.

Calculation of dietary glycemic index is: $GI = \frac{\sum_{i=1}^n (GI_i \times CHO_i)}{\sum_{i=1}^n CHO_i}$

where GI_i is the GI value of food i from the GI database.

TABLE 1 Sample blood glucose responses to the ingestion of 50g carbohydrate

Minutes	0	15	30	45	60	90	120	IAUC
Standard #1	4.3	6.3	7.9	5.3	4.1	4.6	4.9	114
Standard #2	4.0	6.0	6.7	5.5	5.3	5.0	4.2	155



Standard #3 4.1 5.8 8.0 6.5 5.9 4.8 3.9 179

Test Food 4.0 5.0 5.8 5.4 4.8 4.2 4.4 93

This is normally measured in capillary whole blood. Plasma glucose can be used to determine the glycemic index and gives similar values. However, capillary blood is preferred because it is easier to obtain, the rise in blood glucose is greater than in venous plasma and the results for capillary blood glucose are less variable than those for venous plasma glucose. Thus, differences between foods are larger and easier to detect statistically using capillary blood glucose (85). An illustration of the difference between glucose as measured in simultaneously-obtained venous plasma and capillary whole blood is shown in Table 2.

TABLE 2 Glucose response from capillary blood and venous plasma

	0 min	15 min	30 min	45 min	60 min	90 min	120 min	IAUC
Capillary blood	4.1	6.3	9.0	8.7	6.7	5.7	3.9	279
Venous plasma	5.0	7.1	8.8	8.0	5.6	5.4	4.2	155

III. RESULTS

Studies show that the total amount of carbohydrate in food is generally a stronger predictor of blood glucose response than the GI. Based on the research, for most people with diabetes, the best tool for managing blood glucose is carbohydrate counting.

Some clinical studies have shown that a low-GI diet may help people with diabetes control blood glucose levels, although the observed effects may also be attributed to the low-calorie, high-fiber content of the diets prescribed in the study.[5]

Reviews of trials measuring the impact of low-GI index diets on cholesterol have shown fairly consistent evidence that such diets may help lower total cholesterol, as well as low-density lipoproteins (the "bad" cholesterol) — especially when a low-GI diet is combined with an increase in dietary fiber. Low- to moderate-GI foods such as fruits, vegetables and whole grains are generally good sources of fiber. One theory about the effect of a low-GI diet is appetite control. The thinking is that high-GI food causes a rapid increase in blood glucose, a rapid insulin response and a subsequent rapid return to feeling hungry. Low-GI foods would, in turn, delay feelings of hunger. Clinical investigations of this theory have produced mixed results.

Also, if a low-GI diet suppresses appetite, the long-term effect should be that such a diet would result over the long term in people choosing to eat less and better manage their weight. The long-term clinical research does not, however, demonstrate this effect.

Calculation of glycemic index of meals or diets

The GI can be applied in a detailed fashion to mixed meals or whole diets by calculating the weighted GI value of the meal or diet. For example, the way to calculate the GI of a meal containing bread, cereal, sucrose, milk and orange juice is shown in Table 4.

TABLE 3 Calculation of the glycemic index of meals

Food	Grams Carbohydrate	Glycemic Index	Proportion of total Carbohydrate	Food Glycemic Index	Meal Glycemic Index *
Bread	25	100	0.342	100	34.2
Cereal	25	72	0.342	72	24.6
Milk	6	39	0.082	39	3.2
Sucrose	5	87	0.068	87	5.9
Orange juice	12	74	0.164	74	12.1
TOTAL	73				80.0

The glycemic index can be used, in conjunction with information about food composition, to guide food choices. For practical application, the glycemic index is useful to rank foods by developing exchange lists of categories of low glycemic index foods, such as legumes, pearled barley, lightly refined grains (e.g. whole grain pumpernickel bread, or breads made from coarse flour), pasta, etc. Specific local foods should be included in such lists where information is



available (e.g. green bananas in the Caribbean and specific rice varieties in Southeast Asia). In choosing carbohydrate foods, both glycemic index and food composition must be considered. Some low GI foods may not always be a good choice because they are high in fat. Conversely, some high GI foods may be a good choice because of convenience or because they have low energy and high nutrient content. It is not necessary or desirable to exclude or avoid all high GI foods.

IV. CONCLUSION

In order for you to maintain your current weight, you need to burn as many calories as you consume. To lose weight, you need to burn more calories than you consume. Weight loss is best done with a combination of reducing calories in your diet and increasing your physical activity and exercise. Selecting foods based on a glycemic index or glycemic load value may help you manage your weight because many foods that should be included in a well-balanced, low-fat, healthy diet with minimally processed foods — whole-grain products, fruits, vegetables and low-fat dairy products — have low-GI values. For some people, a commercial low-GI diet may provide needed direction to help them make better choices for a healthy diet plan. The researchers who maintain the GI database caution, however, that the "glycemic index should not be used in isolation" and that other nutritional factors — calories, fat, fiber, vitamins and other nutrients — should be considered. [6]

REFERENCES

1. Jenkins DJ, Wolever TM, Taylor RH, Barker H, Fielden H, Baldwin JM, *et al.* Glycemic index of foods: a physiological basis for carbohydrate exchange. *Am J Clin Nutr.* 1981; 34(3):362-6. [Links]
2. Brouns F, Bjorck I, Frayn KN, Gibbs AL, Lang V, Slama G, *et al.* Glycaemic index methodology. *Nutr Res Rev.* 2005; 18(1):145-71. doi: S0954422405000 119[pii]10.1079/NRR2005100. [Links]
3. Food and Agriculture Organization. Carbohydrates in human nutrition: report of a joint food and agriculture report. In: Food and Nutrition Paper. Rome: FAO; 1998 [cited 2011 Oct 10]. Available from: <<http://www.fao.org/docrep/w8079e/w8079e00.htm>> [Links].
4. Wolever TM, Jenkins DJ. The use of the glycemic index in predicting the blood glucose response to mixed meals. *Am J Clin Nutr.* 1986; 43(1):167-72. [Links]
5. Grant SM, Wolever TM. Perceived barriers to application of glycaemic index: valid concerns or lost in translation? *Nutrients.* 2011; 3(3):330-40. doi: 10.3390/nu3030330nutrients-03-00330 [pii] [Links].
6. European Association for the Study of Diabetes Recommendations for the nutritional management of patients with diabetes *Mellitus.* *Eur J Clin Nutr.* 2000; 54:353-5.