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Understanding the GI values of specific foods

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The Glycemic Index

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By David Mendosa

Last Update: October 26, 2009

The glycemic index ranks foods on how they affect our blood glucose levels. This index measures how much your blood glucose increases in the two or three hours after eating.

The glycemic index is about foods high in carbohydrates. Foods high in fat or protein don't cause your blood glucose level to rise much.

A lot of people still think that it is plain table sugar that people with diabetes need to avoid. The experts used to say that, but the glycemic index shows that complex carbohydrates, like baked potatoes, can be even worse.

The glycemic index is about the *quality* of the carbohydrates, not the *quantity*.

When you make use of the glycemic index to prepare healthy meals, it helps to keep your blood glucose levels under control. This is especially important for people with diabetes, although athletes and people who are overweight also stand to benefit from knowing about this relatively new concept in good nutrition.

Recent studies of large numbers of people with diabetes show that those who keep their blood glucose under tight control best avoid the complications that this disease can lead to. Most experts agree that what works best for people with diabetes—and probably the rest of us as well—is regular exercise, little trans fat (partially hydrogenated oils), and a high-fiber diet.

The recommendations to exercise and eat less trans fats is excellent advice—as far as it goes. The real problem is carbohydrates. The official consensus remains that a high-carbohydrate diet is best for people with diabetes. However, some of the experts, led by endocrinologists like Dr. Richard K. Bernstein, recommend a low-carbohydrate diet, because carbohydrates can raise blood glucose to dangerous levels.

But not all carbohydrates act the same. Some are quickly broken down in the intestine, causing the blood glucose level to rise rapidly. These carbohydrates have a high glycemic index.

Please note, however, that a GI value tells you only how rapidly a particular carbohydrate turns into glucose. It doesn't tell you how much of that carbohydrate is in a serving of a particular food. Four extensions of the glycemic index concept noted in the bibliography below address this limitation.

Advanced Glycemic Load Data

A correspondent named Ralph Brown, who is an Excel expert, took the new table of glycemic index and glycemic load values (at <http://www.mendosa.com/gilists.htm>) and added new dimensions to it. He calculated the glycemic load of all the foods per gram or ml and per ounce. He also ranked the glycemic load of foods overall and within their categories. Along the way he discovered nine internal inconsistencies in the new glycemic load calculations. Then I studied the data and found six more inconsistencies. I brought this information to the attention of the team at the University of Sydney in Australia that prepared the original table, and they corrected it. Subsequently, Hilary Ross added an index at the start to make it easier to navigate. Ralph's advanced data with Hilary's index is on-line at http://www.mendosa.com/GI_GL_Carb_data.xls.

- The most important extension is called the glycemic load, which takes the quantity of available carbohydrates into account. Available carbohydrates are those that provide energy, i.e. starch and sugar, but not fiber. The glycemic load measures the effect of the glycemic index of a food times its available carbohydrate content in grams in a standard serving. Harvard School of Public Health professor and researcher Walter Willett, M.D., and his associates developed this concept as long ago as 1997, when they published journal articles on the subject. But it was only in their *Harvard Women's Health Watch* article and Dr. Willett's new book (see bibliography below) that they have published many of the GL numbers. For example, these resources have nice but very short lists of a few foods for which they have calculated the glycemic load (note in particular the high GI and low

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GL of watermelon). Now, however, Jennie Brand-Miller and her associates at the University of Sydney have calculated the GL of all 750 foods for which GI numbers have been calculated. This table was published originally in the July 2002 issue of the *American Journal of Clinical Nutrition*, and I publish an extract of that table on a Web page on this site as authorized by Professor Brand-Miller. She also published the table in the new version of her book, *The New Glucose Revolution*, (Marlowe, January 2003). That table is also a part of *What Makes My Blood Glucose Level Go Up...And Down*, which I wrote with Professor Brand-Miller and Kaye Foster Powell (Marlowe, August 2003).

- Des Buchhorn similarly developed the adjusted carbohydrate exchange, which refines carbohydrate exchange lists by multiplying the glycemic index of a food by its carbohydrate content to indicate the likely effect of a food on blood glucose.
- J.A. Monro, a scientist at the New Zealand Institute for Crop & Food Research, developed the concept of relative glycemic potency, which compares equal weights of foods.
- Derek Paice, an engineer who has type 2 diabetes, similarly developed the concept of the substance glycemic index based on a fixed weight of foods. Derek published his experiments and findings in a 32-page booklet, "Diabetes and Diet: A Type 2 Patient's Successful Efforts at Control." He has authorized me to make the book freely available (in PDF format) at <http://www.mendosa.com/DiabetesAndDiet.pdf>.
- Rich Price developed the Glycemic Matrix to utilize the principle of glycemic density. This is a measurement of the glycemic load in a gram of food. Some researchers think that we tend to eat by food weight and not by calories. Selecting foods low in glycemic density allows us to naturally lower our blood sugar level. The URL is <http://www.scribd.com/RichPrice>

Before the development of the glycemic index beginning in 1981, scientists assumed that our bodies absorbed and digested simple sugars quickly, producing rapid increases in our blood glucose level. This was the basis of the advice to avoid sugar, a proscription recently relaxed by the American Diabetes Association and others.

Now we know that simple sugars don't make your blood glucose rise any more rapidly than some complex carbohydrates do. Of course, simple sugars are simply empty calories, and still should be minimized for that reason.

Many of the glycemic index results have been surprises. For example, baked potatoes have a glycemic index considerably higher than that of table sugar.

A more pleasant surprise is the very low glycemic index of a tasty bean called chana dal, which is the subject of a separate Web page that I maintain at <http://www.mendosa.com/chanadal.html>.

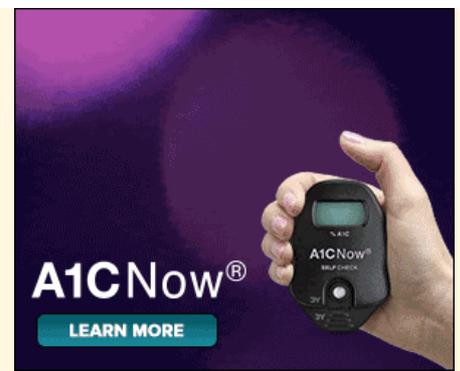
Hulless barley almost certainly has an even lower glycemic index than pearl barley, because pearling removes some of the fiber. A great source of hulless barley that I have used for years is [Bob's Red Mill Natural Foods Inc.](http://www.bobsredmill.com) in Milwaukie, Oregon, phone (503) 654-3215, e-mail jodi@bobsredmill.com.

Scientists have so far measured the glycemic indexes of about 750 high-carbohydrate foods. The key is to eat little of those foods with a high glycemic index and more of those foods with a low index.

Where can you find what these foods are? The easiest way is to refer to another Web page that I maintain. That page at <http://www.mendosa.com/gilists.htm> summarizes the academic research on this important dietary concept.

The GI is especially useful to people with diabetes who want to plan their diets to minimize the incidence of high blood glucose, or spikes. It measures how much of a rise in circulating blood sugar a carbohydrate triggers. The lower the number the less effect it has.

The numbers are percentages with respect to a reference food. They are given here with respect to glucose. In other words, on the scale where glucose equals 100 multiply the GI on this scale by 1.4 to convert to the value on the scale where white bread = 100.



Other Resources

Listings of thousands of foods for their glycemic index and glycemic load follow on a separate Web page. That is so this page won't be so long. Please click on the link at <http://www.mendosa.com/giilists.htm> for these listings.

New editions of the ultimate book about the glycemic index appeared in the UK and Australia in 1998. It has now been published in the U.K. and the U.S.

The first North American edition of the book appeared in July 1999, and third edition came out in 2007. Now titled *The New Glucose Revolution: The Authoritative Guide to the Glycemic Index*, this 347-page book lists for \$16.95 and is published by Marlowe & Company in New York. The North American co-author with Jennie Brand-Miller and her team at the University of Sydney is Thomas M.S. Wolever, M.D., Ph.D., of the University of Toronto, the world's other leading active glycemic index researcher.

The book includes more than 50 recipes and the glycemic index and glycemic load for many foods and beverages. The authors explain the benefits of a diet that emphasizes foods that are low on the glycemic index. These are foods that as they are digested produce a low, slow blood-sugar response.

The book has some very positive endorsements. Here's one example. "Forget *Sugar Busters*. Forget *The Zone*," writes Jean Carper, best-selling author of *Miracle Cures, Stop Aging Now!*, and *Food: Your Miracle Medicine*. "If you want the real scoop on how carbohydrates and sugar affect your body, read this book by the world's leading researchers on the subject. It's the authoritative, last word on choosing foods to control your blood sugar."

Professor Brand-Miller continues her research on the glycemic index, including tests of more foods. Her department at the University of Sydney also undertakes GI testing on a commercial basis. She wrote me recently:

Commercial testing of GI according to standardised methodology in 10 volunteers: Fee is US\$5,000 for the first food with additional foods at US\$2,500 per food. A 10% discount applies to 6 or more foods. Clinical trial protocols can be negotiated at additional cost. In vitro testing of the rate of carbohydrate digestion (a crude guide to the final GI) is also available at US\$500 per food. More information is available at www.glycemicindex.com.

A GI symbol program has been launched in Australia and New Zealand to help consumers easily identify foods that have been properly GI tested. More information is available at <http://www.gisymbol.com.au/pages/index.asp>.

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Thomas Wolever, D.M., Ph.D., professor in the University of Toronto's faculty of medicine, has a company called Glycaemic Index Testing Inc., which is not associated with the university and does commercial testing of the blood glucose responses of foods. It has clients from the U.S., Canada, Japan, UK, Belgium, and Australia. The results of the tests belong to the client, so they cannot be published without the client's permission. "We have a website <http://www.gitesting.com>," Dr. Wolever tells me. "While it is not yet well developed, people can contact us through it. They can also contact me directly at thomas.wolever@utoronto.ca."

If you are trying to lose weight—something of great interest to many people with type 2 diabetes—you may also want to study my Satiety Index page at <http://www.mendosa.com/satiety.htm>. The satiety index, along with the glycemic index, are two of the most exciting tools that we have to control our diabetes.

Perhaps the best current defense of the glycemic index is a commentary by Dr. Thomas M.S. Wolever, "The Glycemic Index: Flogging a Dead Horse?" in the journal *Diabetes Care*. Since *Diabetes Care* chose to not to make it available on-line while making a rebuttal available on-line, I have scanned in an extract of Dr. Wolever's commentary with his permission at <http://www.mendosa.com/wolever.htm>.

Dr. Andrew Weil, the noted writer and lecturer on integrative medicine, has come out strongly for the utility of the glycemic index. See "What's Up with The Zone?" at <http://cgi.pathfinder.com/drweil/>. He writes that "we should pay attention to the glycemic index of carbohydrate foods—that is, the ease with which the body converts them to blood sugar. High-glycemic foods like rice cakes, bread, and potatoes stress the body's insulin system and probably are chief culprits in obesity."

What about Portion Size? And how is GI Determined?

The glycemic index is about the quality of the carbohydrates, not the quantity. Obviously, quantity matters too—and that is the reason for the glycemic load values—but the measurement of the glycemic index of a food is not related to portion size. It remains the same whether you eat 10 grams of it or 1000 grams. That's because to make a fair comparison tests of the glycemic indexes of food usually use 50 grams of available carbohydrate in each food. You *can* eat twice as many carbohydrates in a food that, for example, has a glycemic index of 50 than one that has a glycemic index of 100 and have the same blood glucose response.

Basically, test foods are fed to various people, some with diabetes, others without, in portions that contain 50 grams of *available* carbohydrates. The 50 gram carbohydrate portion is specified in Dr. Wolever's methodology paper (see bibliography below) as 50 grams of available carbohydrates. "That means it excludes the fiber," Professor Brand-Miller writes me. "We have always used a 50 gram available carbohydrate portion and often relied on manufacturers to give us the composition data. I am aware of only one instance where we been given incorrect information and therefore inadvertently included the fiber in the 50 gram carbohydrate portion...but there may be some papers from developing countries where the data is not reliable."

For example, to test boiled spaghetti, the scientists give their subjects 200 grams of spaghetti, which according to standard food composition tables provide 50 grams of available carbohydrate. The scientists compare this response with the volunteer's response to a reference food, which may be either glucose or white bread. Both for the test and for the reference foods the volunteer's response over the next two or three hours is calculated. Rather than measuring a single point, they make the more precise measurement of the area under the curve. Then, they repeat the whole process on different days to reduce the effect of day-to-day variations.

Next, the area under the response curve for the test food is expressed as a percent of the mean value for the reference food for the same subject. Finally, these percentages from each subject are averaged together to obtain the GI for that food. For more information, see Wolever, Thomas M.S. et al. "The Glycemic Index: Methodology and Clinical Implications," listed in the bibliography below.

What Daily Maximums Should We Set?

Here is what Jennie Brand-Miller told me about daily maximums:

"We have worked out here that we should recommend a total GL of about 60 to 80 grams per day for people on a weight loss diet.

"Of course, the GI figures can't be added up like that, but we should encourage people to aim for an average GI of around 50 to 55."

Are there Other Important Diet Considerations?

The glycemic index should not be your only criterion when selecting what to eat. The total amount of carbohydrate, the amount and type of fat, and the fiber and salt content are also important dietary considerations. The glycemic index is most useful when deciding which high-carbohydrate foods to eat. But don't let the glycemic index lull you into eating more carbohydrates than your body can handle, particularly if you have diabetes. The number of grams of carbohydrate we consume is awfully important. Make sure you know the carbohydrate content of the foods you eat—study the nutritional information on the package.

But first you need to decide the composition of your diet in terms of carbohydrate, fat, and protein. Almost all the experts agree that we should minimize our intake of saturated and trans fat and eat a lot more fiber than we do. Some other fats, particularly those from cold-water fish, seem to be beneficial. Beyond that, the battle rages between those who would have us eat more protein and those who say that carbohydrates should provide most of our calories. I'm no expert and am genuinely puzzled myself, although I have begun to cut back on my carbohydrates and eat more protein. Generally, foods high in fat and protein have lower glycemic indexes than foods high in carbohydrate. In a real sense, the glycemic index is not applicable to high-fat and/or high-protein foods.

The problem is that even among the complex carbohydrates not all are created equal. Some break down quickly during digestion and can raise blood glucose to dangerous levels. These are the foods that have higher glycemic indexes. Other carbohydrates break down more slowly, releasing glucose gradually into our blood streams and are said to have lower glycemic indexes.

Before the development of the glycemic index, scientists assumed that our bodies absorbed and digested simple sugars quickly, producing rapid increases in our blood glucose levels. This was the basis of the advice to avoid sugar, a proscription recently relaxed by the American Diabetes Association and others.

Contrariwise, the experts thought that our bodies absorbed starches such as rice and potatoes slowly, causing only small rises in blood glucose. Clinical trials of the glycemic index have also proven that assumption to be false.

Factors such as variety, cooking, and processing may effect a food's GI. Foods particularly sensitive to these factors include bananas, rice, and potatoes (for a fuller discussion of the GI of rice and potatoes see the section below). A 1992 study by Hermansen et al. reported that the GI for

under-ripe bananas was 43 and that for over-ripe bananas was 74. In under-ripe bananas the starch constitutes 80-90 percent of the carbohydrate content, which as the banana ripens changes to free sugars. Particle size is also an important factor, according to a 1988 study by Heaton et al. The researchers found that the GI of wheat, maize, and oats increased from whole grains (lowest GI), cracked grains, coarse flour, to fine flour (highest GI).

In addition, the glucose response to a particular food may be somewhat individual. So it is probably a good idea to carefully watch your own blood glucose level after eating foods you have questions about and determine if they have high or low GI *for you*.

So, the idea of glycemic index is a very useful one. But if you find a specific food produces an unexpected result, either high or low, take note of it and incorporate that into your meal planning.

Also note that the numbers vary from study to study. This may be due to variations in the individuals in a particular study, other foods consumed at the same time, or different methods of preparation, since your body can absorb some foods better when they are well cooked.

Most, but not all, of the foods tested are high in carbohydrates. Some may wonder at the gaps—why other high-carbohydrate low-calorie foods like celery (or tomatoes or similar foods) have never been tested. The problem is a technical one for the testers, because they would be so hard put to get anyone to volunteer to eat 50 grams of carbohydrate from celery—it's just too much celery to think about! Essentially, from a glycemic index standpoint, celery and foods like it can be considered as free foods. I now have a list of the common vegetables and fruits that are free foods on-line at <http://www.mendosa.com/freefoods.htm>.

Mixed Meals

Some people wonder if the glycemic index can predict the effect of a mix meal containing foods with very different indexes. Studies have shown that it does that job very well, too.

More than fifteen studies have looked at the glycemic index of mixed meals. Twelve of them showed an excellent correlation between what was expected and what was actually found.

You can quite readily predict the glycemic index of a mixed meal. Simply multiply the percent of total carbohydrate of each of the foods by its glycemic index and add up the results to get the glycemic index of the meal as a whole. Professor Brand-Miller has an example on page 78 of her book *The New Glucose Revolution*. The report of a Joint FAO/WHO Expert Consultation "Carbohydrates in Human Nutrition" (cited in the Web bibliography below), has a comprehensive explanation and example in its section 6.3.

The three studies that did not show the expected correlation came from a group of researchers who were not using standardized methodology for working out the glycemic index from the area under the curve. In addition, their meals were high in fat, which tends to reduce the impact of any one carbohydrate food.

What About Protein and Fat?

But what if the meal contains protein and fat too, as it usually does? How does that affect our mixed meal calculations?

The conventional wisdom holds that between 50 to 60% of protein becomes glucose and enters the bloodstream about 3 to 4 hours after it's eaten. It's generally accepted that fat has little affect on blood glucose.

In fact, recent studies indicate that neither protein nor fat have more than a minuscule affect on blood glucose. This seems to be true for people both with and without diabetes. The protein studies are particularly interesting.

A 50-gram dose of protein (in the form of very lean beef) resulted in only about 2 grams of glucose being produced and released into circulation. Neither does adding protein to carbohydrate slow the absorption or peak of the glucose response.

Fat delays the peak but not the total glucose response, according to these new studies. Therefore, it looks like you can simply ignore protein and fat in mixed meal calculations.

"Of much greater concern is how protein and fat affect blood glucose levels in the long term," Jennie Brand-Miller of the University of Sydney writes me. "High fat and high protein diets have the distinct potential to induce insulin resistance, which would mean that any carbohydrate eaten would raise blood glucose and insulin levels to greater heights on a day to day basis. However, the type of fat may be important here. A recent study in *Diabetologia* showed that moderately high MUFA [monounsaturated fatty acids] diets improved insulin sensitivity, if the fat was less than a certain level (higher than 37% was associated with insulin resistance)."

For fuller details you can check out the articles themselves:

- Franz, Marion J. "Protein Controversies in Diabetes." *Diabetes Spectrum*, Volume 13, Number 3, 2000, pages 132-141. The URL is <http://journal.diabetes.org/diabetesspectrum/00v13n3/pg132.htm>
- Gannon MC, Nuttall JA, Damberg G, Gupta V, Nuttall FQ. "Effect of Protein Ingestion on the Glucose Appearance Rate in People with Type 2 Diabetes" *The Journal of Clinical Endocrinology & Metabolism*, Volume 86, March 2001, pages 1040-1047. The URL is <http://jcem.endojournals.org/cgi/content/full/86/3/1040>

Pizza

Many people have noticed that pizza seems to keep their blood glucose level high longer than just about any other food. While the reason remains a mystery, this folk wisdom now has scientific confirmation.

Ahern et al. compared the effect on insulin-dependent patients of a pizza meal with a control meal that included high glycemic index foods. They found that although the initial glucose increase was similar for the two meals, the GI continued to rise and was significantly increased from four to nine hours after the pizza meal compared with the control meal.

Rice and Potatoes

Rice and potatoes are some of the foods most tested for their glycemic indexes. They are important both because most of us tend to eat a lot of rice and potatoes and because they can have a high glycemic index. Professor Brand-Miller reports the results of 49 studies of rice and 24 studies of potatoes. The results for rice ranged all the way from 54 to 132 and for potatoes from 67 to 158.

What could possibly cause such tremendous variation? According to Professor Brand-Miller, for rice one of the most important considerations is the ratio of amylose to amylopectin. She says that "the only whole (intact) grain food with a high G.I. factor is low amylose rice, such as Calrose rice...However, some varieties of rice (Basmati, a long grain fragrant rice, and Doongara, a new Australian variety of rice [which is not available in the United States] have intermediate G.I. factors because they have a higher amylose content than normal rice."

Wallace Yokoyama, a research chemist working for the U.S. Department of Agriculture in Albany, California, gave me a comprehensive explanation. There are, says this noted rice specialist, four types of rice: long-grain, medium-grain, short-grain, and sweet rice. Sweet rice is also known as sticky or waxy rice. It makes the best sauces and gravies, and is usually used in Asian restaurants. Sweet rice has *no amylose*, Yokoyama says. In other words, it is the rice that has the highest glycemic index. The three other types of rice have lower glycemic indexes.

Of course, each of these three types of rice may be brown or white. Brown rice has a lower glycemic index than white rice, everything else being equal. Therefore brown long-grain rice—or if you can find it—brown Basmati rice—will probably have a lower glycemic index. White Basmati rice had a glycemic index of 83 in one study. Brown Basmati rice can be expected to have a somewhat

lower index, but we don't know precisely what it is, because the studies haven't been done yet.

In fact, however, Uncle Ben's Converted Rice is the lowest glycemic rice you can get. This is white rice. Jennie Brand-Miller has indicated to me that this company may use a secret process.

[Richard Jackson](#) maintains in e-mail to me that my statement that there are three basic types of rice is "somewhat incorrect." He says that there is also a sweet rice used in oriental cooking. "It is not only very much stickier than standard Asian milled rice (such as Kokuro Rose Brand)," he writes, "but is perceptibly sweeter when eaten. It is typically fermented prior to cooking, whereas standard Japanese-style milled rice is not. I think if more research is done into this factor, the data may prove that the difference between sweet rice and regular Asian-style rice is different on the scale of caloric values as pertains to ingestion by diabetics."

Among potatoes, new and some white potatoes have the lowest indexes. The reason that new potatoes have a lower GI is probably because most of the amylopectin is less branched—it is more like amylose at this immature stage.

Fructose and High Fructose Corn Syrup

An addition to the published glycemic indexes is high fructose corn syrup, which is endemic in U.S. processed foods. Fructose is not the same as high fructose corn syrup, Professor Jennie Brand-Miller emphasized in a message to RonnieDbrg@aol.com, which he kindly faxed to me. "The former is pure fructose; the latter [high fructose corn syrup] is a mixture of fructose and glucose," she wrote. "In high fructose corn syrups, the fructose content is about 50 percent. Thus the GI of high fructose corn syrups is about the same as sucrose, i.e. 60-65 (if glucose = 100)." When white bread = 100, the GI of high fructose corn syrups is 85-92.

Soy Milk

Soy milk has a low glycemic index of 43, according to e-mail from Professor Brand-Miller. The tested soy milk, she writes, has 4.5 grams of carbohydrates, 3.5 grams of fat, and 3.5 grams of protein per 100 ml. A low factor for soy milk isn't surprising, since soybeans have a GI of 25. But consumers in the United States—where many different brands and flavors are available—need to be aware that not all soy milks are created equal.

I recently discovered that my blood glucose rose dramatically after a large cup of chai made with soy milk. That's when I paid attention for the first time to how many grams of carbohydrate that particular soy milk had. So then I looked through the nutrition information on the dozens of brands and flavors of soy milk (and rice milk and almond milk and oat milk, etc.) in our local natural foods store.

I was amazed to find that the carbohydrate content of these beverages varied from 4 grams per 8 oz. to 36 grams. At least five brands have no more than 4 grams of carbohydrate per 8 oz. serving and are made from nothing but water and organic whole soybeans.

WestSoy Organic Unsweetened Soymilk has 5 grams of carbohydrate per 8 oz. serving, of which 4 grams are fiber, which means it has only 1 gram of available carbohydrate per serving. The URL is <http://www.westsoy.biz/products/organic.php>.

Pacific Original Non Dairy Beverage Unsweetened has 5 grams of carbohydrates, but 3 grams are fiber, which means it has only 2 grams of available carbohydrate per serving. The URL is <http://www.pacificfoods.com/>

Soyfresh Unsweetened Soy Beverage also has only 2 grams of available carbohydrate per serving. The URL is <http://www.soyfresh.com>

Plain Yo Soy Traditional Soymilk from Wildwood Natural Foods is almost as low-carb. It has 3 grams of available carbohydrate. The URL is <http://www.wildwoodnaturalfoods.com>

Westbrae Natural Foods' Westsoy 100% Organic Non Dairy Soy Beverage Unsweetened has 4 grams of available carbohydrate. The URL is <http://www.novelco.com/westbrae/>

You may also want to compare these numbers with cow's milk. It has 11 to 13 grams of carbohydrate per 8 oz, whether it is non-fat or full-fat. Also note that the carbohydrates in soy beverages have a lower GI than that of lactose, which is 65.

Thanks

Thanks to Professor Jennie Brand-Miller for authorizing me to reproduce her glycemic index and glycemic load table. Thanks too to Tere Griffin who began the collection of information for what turned into this Web page and originally got me interested in this fascinating subject.

Too Complicated?

There's nothing on my Web site that draws more visitors (and more e-mail questions) than my articles on the glycemic index. Ever since I reviewed the first Australian edition of *The G.I. Factor* by Jennie Brand-Miller and her associates at the University of Sydney for *Diabetes Interview* in August 1996 (online at <http://www.mendosa.com/gifactor.htm>), Jennie and I have maintained a close albeit long-distance relationship.

I brought to her attention an article in *The Washington Post* that was critical of the glycemic index concept. That article, by Lawrence Lindner, executive editor of the *Tufts University Health & Nutrition Letter*, appeared as "What's Your Number, Sweetie? The Glycemic Index Is Science-Based—and Nearly Impossible to Follow," *The Washington Post*, May 1, 2001, is online at <http://www.washingtonpost.com/wp-dyn/articles/A22159-2001Apr30.html>.

Jennie wrote a brilliant and short—and caustic rebuttal. Too trenchant for the Post, the newspaper has not yet published it and probably never will. It is, however, too good to go unread, and Jennie has authorized me to reproduce her letter here:

Imagine setting up a system of rating the energy content of foods and assigning a number—let's call them calories, the higher the number, the more energy they contain and the greater their likelihood of causing weight gain. We could use this system to guide food choices to lower energy intake.

Unfortunately, it's not that simple! The number would not tell us anything about the vitamin, mineral or fiber content. The numbers could be misleading—some highly nutritious foods like nuts and legumes have terribly high numbers (calories), while some nutritionally worthless foods have very low numbers (e.g. diet soda). What's more the numbers are not set in stone—they vary from time to time and just a slight change in the recipe would alter the number drastically. Let's dump the concept—it's way too difficult to follow.

The worth of any food cannot be measured by a single number, but a single number can tell you a great deal about how the carbohydrate in that food affects blood glucose levels. High blood glucose levels are a risk factor for diabetes and cardiovascular disease. Dozens of studies have shown improvements in a variety of clinical outcomes with free-living subjects consuming self-selected low glycemic index diets.

Like the calorie content of food, the glycemic index deserves some consideration. The foods that provide the most carbohydrate in the diet are the ones that need close attention (potatoes, breakfast cereals, breads, soft drinks), not carrots, honey or over-ripe bananas.

Sincerely,

Jennie Brand-Miller PhD
Associate Professor of Human Nutrition
University of Sydney, Australia

Bibliography:

Among the literally hundreds of studies of the glycemic index in the scientific literature, these are some of the most important and most recent:

- Ahern, J.A., et al. "Exaggerated hyperglycemia after a pizza meal in well-controlled diabetics." *Diabetes Care*, Vol 16, April 1993, pp. 578-80.
- Arnot, Robert. *Dr. Bob Arnot's Revolutionary Weight Control Program*. (New York: Little, Brown and Company, 1997), 305 pages, \$23.95. Little, Brown and Company brought out a paperback version of the book in May 1998 for \$13.95. A key focus of this book is that by dropping what Dr. Arnot calls your "glucose load" you can lose weight. By glucose load, Dr. Arnot means the glycemic index. "The greater the number or higher GI foods you eat, the higher your total glucose load," he writes. Chapter 6, "Drop Your Glucose Load," is right on target. This new and outstanding book probably makes better use of modern scientific concepts like the glycemic index than any other weight control book.
- Bahan, Deanie Comeaux. *Sugarfree New Orleans: A Cookbook Based on the Glycemic Index*. (New Orleans: AFM Publishing LLC, 1997), 171 pages. Here is a practical application of the glycemic index by someone who really understands how it works. The book is available in book stores or by mail order for \$15.95 + \$2.50 s/h. The ordering information is:
Sugarfree New Orleans
PO Box 750855
New Orleans, LA 70175
(504) 269-3463
- Brand Miller, Janette, et al. "Rice: a High or Low Glycemic Index Food?" *The American Journal of Clinical Nutrition*, Vol. 56, 1992, pp. 1034-1036.

- Brand-Miller, Jennie, Kaye Foster-Powell, and Rick (David) Mendosa. *What Makes My Blood Glucose Go Up...and Down? And 101 Other Frequently Asked Questions About Your Blood Glucose Levels* New York: Marlowe & Company, 2003, 196 paperback pages. \$9.95. A bite-sized introduction to the glycemic index and glycemic load; includes the complete table of some 750 tested foods. Hodder Headline will publish an Australian edition in early 2004.
- Brand-Miller, Jennie, "Low-Glycemic Index Diets in the Management of Diabetes: A meta-analysis of randomized controlled trials," *Diabetes Care*, Vol 26, No. 8, 2003, pages 2261-2267. Online at <http://care.diabetesjournals.org/cgi/content/full/26/8/2261>
- Brand-Miller, Jennie, Thomas M.S. Wolever, Kaye Foster-Powell, and Stephen Colagiuri, *The New Glucose Revolution: The Authoritative Guide to the Glycemic Index—the Dietary Solution for Lifelong Health* New York: Marlowe & Company, 2003, 348 paperback pages. \$15.95. This is the updated U.S. edition of *The G.I. Factor: The Glycaemic Index Solution*. Sydney: Hodder Headline, 1996. 250 paperback pages. This is the "bible" of glycemic index studies.
- Brand-Miller, Jennie, Kaye Foster-Powell, and Joanna McMillan-Price, *The Low GI Diet Cookbook: 100 Simple, Delicious Smart-Carb Recipes-The Proven Way to Lose Weight and Eat for Lifelong Health* New York: Marlowe & Company, 2005, 176 paperback pages. \$19.95.
- Buchhorn, Des. "Adjusted carbohydrate exchange: food exchanges for diabetes management corrected with the glycaemic index." *Australian Journal of Nutrition and Dietetics*, Volume 54, 1997, pp. 65-68. The adjusted carbohydrate exchange (ACE) refines carbohydrate exchange lists by multiplying the glycemic index of a food by its carbohydrate content to indicate the likely effect of a food on blood glucose. Thanks to [Joanna Hutchison](#) for bringing this imaginative extension of the glycemic index to my attention.
- Foster-Powell, Kaye, Susanna HA Holt, and Janette C Brand-Miller. "International table of glycemic index and glycemic load values: 2002." *The American Journal of Clinical Nutrition*, Vol. 76, 2002, pp. 5-56. This extensive table lists 750 foods and is the definitive journal article. It updates the first comprehensive listing of glycemic index results: Kaye Foster-Powell and Janette Brand Miller. "International tables of glycemic index." *The American Journal of Clinical Nutrition*, Vol. 62 (supplement), 1995, pp. 871S-893S. This long article is now finally free online at <http://www.ajcn.org/cgi/content/full/76/1/5>
- Foster-Powell, Kaye, Jennie Brand Miller and Stephen Colagiuri. *Pocket Guide to the G.I. Factor for People with Diabetes*. Hodder Headline Australia Pty Limited, 1997. 96 small—4.25"x5.5"—paperback pages. Price A\$6.95 (approximately US\$4.95). This is a companion volume to *The G.I. Factor* that adds new information, including the number of grams of fat and carbohydrates along with the glycemic index of some 300 different foods.
- Gittleman, Ann Louise. *Get the Sugar Out: 501 Simple Ways to Cut the Sugar Out of Any Diet*. New York: Three Rivers Press, 1996. 186 paperback pages. Price \$11. This book is fundamentally based on the glycemic index—and the author's understanding of the glycemic index is fundamentally flawed. The pages on the glycemic index in the preface (xvii through xxi) are worse than useless. Riddled with mistakes, it makes the unpardonable error of equating the glycemic index of glucose and that of white bread (as well as whole-wheat bread) as being 100. This mistake must be the result of sloppy reading of different presentations of the glycemic index that are indeed based on one or the other of these food products. However, glucose has a GI about 40 percent higher than that of white bread.
- Gallop, Rick. *The G.I. Diet: The Easy, Healthy Way to Permanent Weight Loss*. Canada, Random House Canada, 2002. 178 paperback pages. Price Canadian \$24.95. Rick Gallop wrote this book when he was the president of the Heart and Stroke Foundation of Ontario, Canada. In that capacity he learned about Barry Sears's *The Zone* diet, which is based on the principles of the glycemic index. Himself overweight, he lost 20 pounds on *The Zone*. But, he says, 95 percent of the people who tried to follow that diet dropped out within a year. Dismayed by that dropout rate, Gallop set out to address the two key impediments to success: complexity and hunger. His book is the result. It's further described on the Web at http://www.randomhouse.ca/catalog/display_can.pperl?isbn=0679310568 and <http://www.gidiet.com/>
- Hermansen, K., et al. "Influence of ripeness of banana on the blood glucose and insulin response in type 2 diabetic subjects." *Diabetic Medicine*, Vol. 9, October 1992, pp. 739-43.
- Heaton, Kenneth W. et al. "Particle size of wheat, maize, and oat test meals: effects on plasma glucose and insulin responses and on the rate of starch digestion in vitro." *The American Journal of Clinical Nutrition*, Vol. 47, 1988, pp. 675-682.
- Holt, Susanne H.A., Janette C. Brand Miller, and Peter Petocz. "An insulin index of foods: the insulin demand generated by 1000-kJ portions of common foods." *The American Journal of Clinical Nutrition*, Vol. 66, 1997, pp. 1264-76. This recent paper fills two of the most important gaps in glycemic index research: (1) comparisons between glucose responses measured by the glycemic index and insulin responses as measured by an insulin index and (2) comparisons of foods on the basis of total equal calorie portions instead of equal carbohydrate calorie portions, which is what glycemic index studies otherwise use.

The authors tested 38 foods in six food categories (fruit, bakery products, snacks, carbohydrate-rich foods, protein-rich foods, and breakfast cereals). They found a high correlation between glucose

and insulin scores, although bakery products, which are high in fat and refined carbohydrates, and protein-rich foods gave disproportionately higher insulin responses than glycemic responses. Some protein-rich and fat-rich foods induced as much insulin secretion as did some carbohydrate-rich foods.

Each of the tests compared 1000-kJ portions, which is equal to about 240 calories. Each subject first consumed a 1000-kJ portion of white bread (45.9 g carbohydrate) to confirm normal glucose tolerance. The study also used white bread as the reference food against which they compared all other foods, similar to the method used for calculating GI values.

- Jenkins, David J.A., et al. "Glycemic Index of Foods: a Physiological Basis for Carbohydrate Exchange." *The American Journal of Clinical Nutrition*, Vol. 34, March 1981, pp. 362-366. The initial glycemic index research. A classic.
- Jenkins, D.J.A. and Jenkins, A.L. "Treatment of hypertriglyceridemia and diabetes." *Journal of the American College of Nutrition*, Vol 6, 1987, pp.11-17.
- Jenkins, David J.A. et al. "Starchy Foods and Glycemic Index." *Diabetes Care*, Vol. 11, No. 2, February 1988, pp. 149-159.
- Lipetz, Philip. *The Good Calorie Diet*. HarperSpotlight paperback, 1994. 276 pages. \$5.99. Its contains up-to-date discussions of the effects of the glycemic (and fat) content of some 3,000 foods separately listed for their good and bad calorie effect. An appendix lists the glycemic index of about 137 foods. Thanks to [Deb Branson](#) for bringing this book to my attention.
- Lipetz, Philip, and Monika Pichler. *Naturally Slim and Powerful*. Andrews and McMeel, 1997. 254 pages. \$19.95. This low-fat food regimen is designed for women and uses the glycemic index to increase serotonin levels. It includes a listing of foods with their glycemic index, menu suggestions, and recipes. Thanks to [Carol Carvajal](#) for bringing this book to my attention.
- Liu, P, T. Perry and J.A. Monro. "Glycaemic glucose equivalent: validation as a predictor of the relative glycaemic effect of foods." *European Journal of Clinical Nutrition*, in press 2003. GGE content predicts glycemic impact of foods over a practical range of carbohydrate intakes and may therefore be useful for accurate dietary management of glycemia in diabetes.
- Ludwig, David S., et al. "High Glycemic Index Foods, Overeating, and Obesity." *Pediatrics*, Vol. 103, No. 3, March 1999, p. e26 ff. This study, much reported in the popular press, demonstrated that the rapid absorption of glucose that follows the consumption of foods with a high glycemic index may trigger hormonal changes that lead to overeating. The study is on-line at <http://www.pediatrics.org/cgi/content/full/103/3/e26>
- Ludwig, David S. "The Glycemic Index: Physiological Mechanisms Relating to Obesity, Diabetes, and Cardiovascular Disease." *JAMA*, Vol. 287, No. 18, pp. 2414-2423. Dr. David Ludwig of the Boston Children's Hospital gives the glycemic index a big boost in the May 8 issue of the *Journal of the American Medical Association*, perhaps the country's most prestigious medical journal. This support should help resolve some of the controversies over the glycemic index that still linger here. "The habitual consumption of high-glycemic index foods may increase risk for obesity, type 2 diabetes, and heart disease," Dr. Ludwig concludes. "Despite areas of continuing controversy, clinical use of glycemic index as a qualitative guide to food selection would seem to be prudent in view of the preponderance of evidence suggesting benefit and absence of adverse effects."
- Manore, Melinda M. Using Glycemic Index to Improve Athletic Performance. This article is on-line at http://www.gssiweb.com/reflib/refs/623/ssn_glycemic.cfm?pid=38
- Miller, Campbell J., et al. "The Glycaemic Index of three varieties of dates." *Saudi Medical Journal*, Vol 23, No. 5, May 2002, pp. 536-538.
- Monro, John A., and Mike Williams. "Concurrent management of postprandial glycaemia and nutrient intake using glycaemic glucose equivalents, food composition data and computer-assisted meal design," *Asia Pacific Journal of Clinical Nutrition*, Vol. 9, 2000, pp.67-73. Dr. Monro's recent article took the glycemic index a giant step forward. By multiplying the glycemic index of hundreds of foods by the proportion of carbohydrates that those foods contain he has developed a table of the relative glycemic potency (RGP) of these foods, a classification of whole foods according to their immediate impact on blood glucose levels. The RPG compares equal weights of foods. Further, he has determined the glycemic glucose equivalents (GGE) of these foods so different amounts of different foods can be compared directly according to their glycemic impact. The GGE is a quantity in grams, allowing it to be treated in the same way as nutrients.
- Monro, John. "Food Exchange Tables for Control of Postprandial Glycaemia," *Journal of the New Zealand Dietetic Association*, April 1999, pp. 11-21. Here are tables for more than 100 foods common in New Zealand (and elsewhere) on the basis of the glycemic index adjusted exchange values described in the previous listing.
- Monro, John A. "Glycaemic glucose equivalent: combining carbohydrate content, quantity and glycaemic index of foods for precision in glycaemia management," *Asia Pacific Journal of Clinical Nutrition*, Vol 11, 2002, pp. 217-225. Now that the glycemic load is calculated on the basis of a single serving and uses a glucose-based GI, the values for GL/serving and GGE content/serving are the same. In other words, as Dr. Monro writes me, GGE can be regarded as the units for GL.
- Montignac, Michel. *Eat Yourself Slim*. Baltimore: Erika House Book Publishers, May 1999. 296 paperback pages. Price \$19.95. This is new American edition of Michel Montignac's French classic

—the first book to promote the glycemic index for weight loss. An extensive Web site about the book can be found at <http://www.montignacusa.com/>.

- Montignac, Michel. *Eat Yourself Slim*. Canadian edition published by Michel-Ange Publishing, June 1999. 228 pages. Price \$19.95. Amazon.com links it at <http://www.amazon.com/exec/obidos/ASIN/0968402909/o/qid%3D942164902/sr%3D8-1/102/002-9506817-4264213>, and it is scheduled to be available at <http://www.montignac-intl.com/> soon.
- National Diabetes Information Clearinghouse, a Service of the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health. *Diabetes and the Glycemic Index Information Packet*. March 1996, 9 pages. While the U.S. Government does not endorse the glycemic index, this information packet certainly shows that it recognizes the concept. The packet consists of two articles:
 1. Dinsmoor, Robert S. "The Glycemic Index," *Diabetes Self-Management*, Winter 1984-85, pages 22-24. A very early popularization of the work of Dr. David Jenkins, who developed the glycemic index concept in 1981.
 2. Brand Miller, Janette C. "Importance of glycemic index in diabetes" *American Journal of Clinical Nutrition*, Vol. 59 (supplement), 1994, pp. 747S-752S. A comprehensive and professional review of the literature.
- Paice, Derek A. *Diabetes and Diet: A Type 2 Patient's Successful Efforts at Control*. Paice & Associates Inc., 114 Rosewood Court, Palm Harbor, FL 34685, 1997. On-line at <http://www.mendosa.com/DiabetesAndDiet.pdf>
- Perricone, Nicolas, M.D. *The Perricone Prescription: A Physician's 28-Day Program for Total Body and Face Rejuvenation*. HarperCollins, 2002. 274 pages. I probably should be more appreciative of his plug to this Web page on page 37 of his book. But I need to point out a couple of errors in the book. He says that he is using the index "with 100 indicating the increase in blood glucose levels resulting from eating table sugar." No, it's a different sugar—glucose. He also says that "good old-fashioned rolled barley packs a wallop at 100." It's hard to figure out what he's talking about, but old-fashioned pearled barley has a GI of 25 and rolled barley tested in Australia has a GI of 66.
- Podell, Richard N., and William Proctor. *The G-Index Diet*. WarnerBooks Inc., 1993. 292 pages. A popularization of the glycemic index for weight loss.
- "Point/Counterpoint Glycemic Index: Pro and Con," *Nutrition Today*, Vol. 34, March/April 1999, pp. 64-88. The best series of articles on the advantages and disadvantages of the glycemic index available anywhere, by experts in the field, including Janette Brand-Miller and Kaye Foster-Powell; Thomas M.S. Wolever (pro); Marion J. Franz; Christine Beebe (con); and Helen Katanas (pro).
- Salmerón, Jorge, et al. "Dietary Fiber, Glycemic Load, and Risk of Non-insulin-dependent Diabetes Mellitus in Women." *The Journal of the American Medical Association*, Vol. 277, February 12, 1997, pp. 472-477. One of the most important findings to come out the Nurses' Health Study of 121,700 U.S. female registered nurses over many years, this landmark study recognizes the glycemic index in the prestigious journal JAMA for perhaps the first time.
- Smith, Ulf. "Carbohydrates, Fat, and Insulin Action." *The American Journal of Clinical Nutrition*, Vol. 59 (supplement), 1994, pp. 686S-689S.
- Steward, H. Leighton et al. *Sugar Busters! Cut Sugar to Trim Fat*. New York: Ballantine Books, 1998, \$22. Inspired by Michel Montignac's *Eat Yourself Slim* (see listing above), this book by a businessman and three medical doctors is based on the glycemic index. This 270-page hardcover book is a substantial expansion of the 143-page paperback, which they self-published in 1995. My review of this book was published in the September 1998 issue of *Diabetes Interview* magazine and is online at <http://www.mendosa.com/sugar.htm>. Associated with the book is a Web site at [SUGAR BUSTERS!](http://www.mendosa.com/sugar.htm)
- Thomas, D.E., Brotherhood, J.R., and Brand, J.C. "Carbohydrate feeding before exercise: effect of the glycemic index." *International Journal of Sports Medicine*, Vol 12, 1991, pp.180-186.
- Trout, D.L., Behall, K.M., and Osilesi, O. "Prediction of glycemic index for starchy foods." *The American Journal of Clinical Nutrition*, Vol. 58, 1993, pp. 873-8.
- Wahlqvist, M.L. (Department of Medicine, Monash University, Monash Medical Centre, Clayton, VIC., Australia). "Nutrition and diabetes." *Australian Family Physician*, Vol 26, April 1997, pages 384-389. For short term (acute meal response) and longer term glycaemic control, as well as an aid to satiety, low fat glycaemic index foods are encouraged.
- Whitaker, Julian. "My Latest Thinking on Diet: All Carbohydrates Are Not Created Equal." *Dr. Julian Whitaker's Health & Healing*, January 1998 (Special Supplement). In two pages Dr. Whitaker aptly summarizes the case for the glycemic index. In a nutshell, this is what he says: "For years I have advocated a diet very high in complex carbohydrates and painted excessive fat as the villain. While I maintain my stance on the deleterious effects of excessive fats, new research has convinced me that excessive carbohydrates pose similar risks....Recent research...has added a twist to the simple/complex carbohydrates game--the glycemic index. It is a way of evaluating foods according to how quickly they are metabolized into glucose. Foods with a high glycemic index enter the bloodstream rapidly, while low glycemic foods promote a slower release of glucose and insulin. This means you should go easy on high glycemic foods. The bulk of your diet should be low glycemic complex carbohydrates."

- Willett, Walter C. *Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating*. New York: Simon & Schuster Source, 2001. 299 pages. \$25. Dr. Willett originated the concept of the glycemic load as an extension of the glycemic index and calculates the glycemic load of 34 foods here (pages 90-91).
- Wolever, Thomas M.S. et al. "The Glycemic Index: Methodology and Clinical Implications." *The American Journal of Clinical Nutrition*, Vol. 54, 1991, pp. 846- 854, online at <http://www.ajcn.org/cgi/reprint/54/5/846>
- Wolever, Thomas M.S. et al. "Glycemic Index of Fruits and Fruit Products in Patients with Diabetes." *The International Journal of Food Sciences and Nutrition*, Vol. 43, 1993, pp.205-212.
- Woodruff, Sandra. *The Good Carb Cookbook: Secrets of Eating Low on the Glycemic Index*. New York: Avery, 2001. 312 paperback pages. \$15.95.

The Glycemic Index Elsewhere on the Internet:

- Food2Live is a personalized calculator of glycemic load, calories, and nutrients. The URL is <http://www.food2live.com>
- "Glycemic Index and Glycemic Load Lists" is a Web page by Malcolm Graham. The site includes a Palm-based SmartList database of Glycemic Index and Glycemic Load values. The URL is <http://diabetestype2.ca/glycemic/>
- [Greg Watson](#) in Adelaide, South Australia, has an extensive Web page on "Carbs, Glycemic Index & Glycemic Load" at <http://optimalhealth.cia.com.au/gi17.html>. If you have Excel on your computer, especially interesting is his [Interactive Glycemic Load Excel Spreadsheet](#). His data appears to be from the same source as my page at <http://www.mendosa.com/gifactor.htm>, except unlike everyone else he doesn't divide the glycemic load by 100.
- "Diabetes & Diet" offers excellent advice from Malcolm Graham. The URL is <http://diabetestype2.ca/diet.htm>
- The Glycemic Index Foundation of South Africa has a comprehensive GI site customized to focus on foods available there. Particularly strong is the site's bibliography. The URL is <http://www.gifoundation.com>
- **The Glycemic Index On-line, the University of Sydney's GI Website, is a comprehensive and authoritative guide to the glycemic index. Dr. Jennie Brand-Miller, who authorized me to summarize her work in 1995 or 1996, finally has a Web presence in November 2000. And what a presence it is! Her site is now the key Internet resource on this subject. The URL is <http://www.glycemicindex.com>**
- A recent review of the literature on the glycemic index is a paper by Maria Kalergis, MSc RD, Danièle Pacaud, MD, Jean-François Yale, MD, "Attempts to Control the Glycemic Response to Carbohydrate in Diabetes Mellitus: Overview and Practical Implications" in the *Canadian Journal of Diabetes Care* 22(1):20-29, 1998.
- The most scientific background on the glycemic index on the Web is "Carbohydrates in Human Nutrition; Interim Report of a Joint FAO/WHO Expert Consultation, Rome, Italy, 14 to 18 April 1997." This report by an international committee of carbohydrate experts assembled by the United Nations reports on the current scientific knowledge of carbohydrates, which turns out to be much more complex than a layman like myself has ever dreamed possible. It also contains a valuable section on the glycemic index itself, "The Role of the Glycemic Index in Food Choice." The URL is <http://www.fao.org/docrep/w8079e/w8079e0a.htm>
- A new NutriGenie Glycemic Index Diet for Windows (released February 10, 1997) "has the GI ratings (low, medium and high) for over 500 most common foods," but does not show actual ratings. The source of their data is not stated. E-mail from the company says, "We use many sources for our data, some for just a few entries. In addition the classification can be revised by users if they choose, so naming the sources for GI is not necessary." Really? This shareware program, available for \$39, is available as crippleware on the Internet at <http://members.aol.com/nutrigenie/nggid48.html> and other sites.
- Now the glycemic index is even available in Spanish at El índice glucémico. Para información o comentarios sobre la producción y edición de estas páginas dirigirse a [Fernando Martín](#). The information presented is based on glucose = 100. The URL is <http://laisla.com/uned/diabetes/indgluce.htm>
- Another article on the glycemic index in Spanish, "Importancia del índice glucémico," can be found online at http://www.diabetesonline.com.ar/diabetes/art_88.htm.
- An editorial about the glycemic index rebutting the commentary by Dr. Thomas M.S. Wolever, "The Glycemic Index: Flogging a Dead Horse?" in the journal *Diabetes Care* is on-line at <http://care.diabetesjournals.org/cgi/content/abstract/20/3/452>. For some unexplained reason, *Diabetes Care* has made the rebuttal available on-line without making Dr. Wolever's commentary available there. Therefore, I have scanned in an extract of Dr. Wolever's commentary with his kind permission at <http://www.mendosa.com/wolever.htm>.
- The Montignac Universal Web site has a short "Glycaemic Index Table" based on glucose = 100 at <http://www.montignac.com/en/gindex.html>

- The official Michel Montignac website in both English and French in Quebec, Canada, is his weight-loss clinic based in part on the glycemic index. The URL is at <http://www.montignac-intl.com/>
- Marcel Bovy in Amsterdam, Holland, has a fine review of the diet method developed by Michel Montignac, which makes considerable use of the glycemic index. The URL is <http://www.boverwey.cistron.nl/montignac>
- "The Glycemic Index: How quickly do foods raise your blood sugar?" is an attractively presented page on the Diabetes Mall. The URL is <http://www.diabetesnet.com/gi.html>
- Here's another excellent glycemic index resource for athletes. Cycling Performance Tips: Glycemic Index shows how athletes can make use of the glycemic index. The URL is <http://www.cptips.com/gi.htm>

Software:

- The GI/GL calculator is an outstanding web application that uses a database of glycemic index, glycemic load, and other measures to calculate their totals for entire meals. Since it has an application-like user interface with a tree-view and a free-text search option, it is quite easy to use, despite its capabilities. On the average home computer it is also really fast, since the database is downloaded to the browser when the application starts. The URL is http://www.menialtools.com/GI_calculator.php
- "The Glycaemic Index Meal Planner makes following the GI Diet as easy as A B C," says Daniel McKeever, whose company, Solution Forty-Two, developed the software. The application presents about 1,500 pre-loaded food items in a clear and concise way using simple color coding. Using a powerful search utility, the user is able to create meals and days replacing high GI foods with low GI foods. Other features include automatic meal and day GI value calculations; week planning; links to favorite websites; a diary; it will even produce your shopping lists. It sells for £9.95, which is about US\$17.50, and PayPal will make the conversion. The URL is <http://www.gimealplanner.com>
- A program called GlycoLoad takes the current glycemic index and glycemic load list and creates a graphical interface for determining the load based on the amount of food that you eat. It sells for \$15.95 and runs on Windows 98 or better. A Pocket PC version is in the works. The URL is <http://www.phelpsteam.com/glycoload>
- The Glycemic Index Meal Planner software calculates the overall Glycemic Index and Glycemic Load for meals and the day. There are versions of the Glycemic Diet Software program for PCs, Palm Pilot, and Palm Mac. The URL is <http://www.glycemicdietsw.com>
- NutriGenie Glucose Revolution Diet for Windows has the glycemic index ratings (low, medium or high) for over 2,500 commonly used food items in its database. The URL is <http://nutrigenie.biz/nggrd.html>

Video:

- Sweet Fire is an imaginative 65-minute video presentation by nutrition educator Mary Toscano explaining the concepts behind the glycemic index. However, from looking at the full title of the video—"Sweet Fire: Understanding Sugar's Role in Your Health"—you wouldn't know this. In fact, Ms. Toscano implies that it is sugar and not starch that causes blood glucose levels to rise rapidly. She differentiates between simple carbohydrates—the sugars—and complex ones—the starches, a differentiation outmoded by the glycemic index itself. "Carbohydrates are broken up into two categories, simple and complex," she says. "Simple are the sugars. The complex are the starches. A starch is a bunch of sugar molecules tied together. So all carbohydrates are sugar. The shorter the chain the sweeter the taste." She ignores the fact that some sugars are very low glycemic (and therefore slowly digested)—like fructose with a GI value of about 20—while others are high glycemic (and therefore digested quickly)—like glucose and maltose with GI values of about 100. She ignores the fact that a baked Russet potato, for example, has a higher GI value than sucrose (table sugar), even though (according to USDA data at http://www.nal.usda.gov/fnic/cgi-bin/list_nut.pl) 95 percent of this potato's available carbohydrate is starch and only 5 percent is sugar. However, the purpose of her presentation, at which she succeeds very well, seems to make people aware of the amount of junk food that we eat. But judging from some her statements and references, her emphasis seems to be more on low carb than low glycemic. For example, she says that to avoid getting diabetes you should "become aware of the carbohydrates you are eating...the more sensitive you are to sugar the more you should limit your carbohydrates. If you are diabetic already, you should really be limiting your carbohydrates." The video is available in DVD format for \$24.95 and on VHS tape for \$29.95 from <http://www.marytoscano.com/sweetfire/>





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can help reduce harmful spikes in blood sugar, as sugars and carbohydrates are broken down and your metabolism releases insulin to aid in digestion. Limiting your intake of high GI foods is a first-step towards controlling your cravings, increasing energy, and weight loss. The GI is entirely based on the quality of The glycemic index. Dr. David Jenkins created the GI to rank carbohydrates for people with diabetes. Instead of categorizing carbohydrates as simple or complex, the GI ranks foods on a scale from 0 to 100. Foods that quickly raise blood glucose levels have a higher GI number than foods that raise blood glucose levels more slowly. Avoiding spikes. Your body responds to blood glucose spikes by producing more insulin. Insulin is a hormone that allows glucose to go from your blood into your cells. The Glycemic Index (GI) is a relative ranking of carbohydrate in foods according to how they affect blood glucose levels. Carbohydrates with a low GI value (55 or less) are more slowly digested, absorbed and metabolised and cause a lower and slower rise in blood glucose and, therefore usually, insulin levels.

The glycemic index (GI) is a numerical system of measuring how much of a rise in circulating blood sugar a carbohydrate triggers—the higher the number, the greater the blood sugar response. So a low GI food will cause a small rise, while a high GI food will trigger a dramatic spike. A list of carbohydrates with their glycemic values is shown below. A GI of 70 or more is high, a GI of 56 to 69 inclusive is medium, and a GI of 55 or less is low. Glycemic index, also called glycaemic index (GI), is a ranking system for carbohydrates based on their effect on blood glucose levels in the first two hours after eating. It compares carbohydrates gram for gram in individual foods, providing a numerical, evidence-based index of post-meal (medically called: postprandial) glycemia. The concept of glycemic index was developed by Dr. David J. Jenkins and colleagues in 1981 at the University of Toronto.