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GLYCEMIC INDEX: PROS AND CONS

By G. Harvey Anderson, Ph.D.

Carbohydrates (CHOs) are the most important energy source in the majority of human diets. In the past, they were classified by their molecular size as sugar, oligosaccharides, polysaccharides, and polyols (hydrogenated CHOs). However, the goal of having a physiologic measure of the impact of carbohydrate foods on blood glucose was motivated by the desire to provide dietary advice for the control of blood glucose in diabetic persons.

The notion of adding a physiologic measure of carbohydrate quality to the chemical definitions was proposed in the early 1970s when the concept of carbohydrate exchange for diabetics was developed.[1] The approach was put on a more quantitative basis as a result of the development of the glycemic index (GI) by Jenkins.[2] Glycemic index is defined as the incremental area under the 2-hour blood glucose response curve (IAUC) of a fixed amount, usually 50 g, of available CHOs of a test food expressed as a percentage of the response to the same amount of CHOs from either white bread or glucose when taken by the same subject. Carbohydrates that breakdown quickly during digestion have the highest glycemic index, and the blood glucose curve is high. Those that are slowly digested result in much lower AUC over the two hours and, it is assumed, a lower insulin response. But this relationship is linear only if pure CHOs or primarily carbohydrate foods are consumed. The glycemic load (GL) of foods, meals and diets is calculated by multiplying the GI by the amount of carbohydrate in the food.

Since 1981 many foods have been assayed to produce a quantitative number ranking the effect of foods on blood glucose immediately following their ingestion and based on their carbohydrate content. Catalogues of the GI of many foods have been published.[3, 4] In general, processed foods made from grain flour such as snack foods, breads and ready to eat cereals have a high GI. On the other hand, whole grains, pasta and fruits have a moderate GI. The lowest glycemic response is associated with legumes and dairy products.

The promoters of the concept claim that quantitative knowledge of the effect of a food on blood glucose allows for the selection of foods and the construction of diets that minimize fluctuations in blood glucose and insulin, improve glucose and lipid metabolism in diabetes, lower blood triglycerides, if elevated, and benefit weight control and athletic performance. At present, however, there are polarized views on the merits of the GI and especially the need to have foods labeled with it, as has

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GI/GL Ranges

GLYCEMIC INDEX

Low GI = ≤ 55
Moderate GI = 56-69
High GI = 70+

GLYCEMIC LOAD

Low GI = ≤ 10
Moderate GI = 11-19
High GI = 20+

Editor's Note:
Application of the glycemic index to dietary recommendations remains controversial, as the science in this area continues to evolve. This issue of ***The Soy Connection*** *presents opposing views in this area. The ADA position paper on the topic is available online at http://www.eatright.org/ada/files/GlycemicIndex.pdf.*

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SOYFOODS IN A LOW GI DIET

By Michelle Babb, M.S.

As Americans start to rebound from the low-carb craze, inspired in large part by the Atkins diet, there is a newfound interest in examining the *types* of carbohydrates we're eating rather than avoiding them altogether. Hence, the glycemic index (GI).

"...adoption of a low-glycemic diet as a means to help manage blood glucose levels and reduce the incidence of obesity,"

GI is a measurement of how fast 50 g of a given carbohydrate raises blood glucose levels as it is digested.[1] While the GI of a given food provides precise information about how 50 g of that food will affect blood glucose levels, researchers from Harvard University decided it would be even more useful to be able to measure the effect of a standard portion of that food on blood glucose levels. The formula they devised (GI x carbohydrate per serving ÷ 100) determines what is known as the glycemic load (GL). For example, soymilk has a GI of 44 and a GL of only 8 per 8 oz. serving.[2] (These figures will vary slightly among brands.)

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GI: PROS & CONS

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occurred in Australia, Sweden and South Africa. The assay of foods for their GI has also become a commercial business not only for the promoters of the concept but other laboratories.

The critics of the concept suggest that clinical utility is in doubt because many components of food affect glucose response, blood lipids and weight control and because insulin response to carbohydrate foods is the more important measure. Public health application is also thought to be doubtful because of public misunderstandings of the label and of monitoring and regulating the label claim because the composition of processed foods are often changed quickly by manufacturers based on the price of ingredients. The legal liability of a label claim with an unpredictable outcome has also been raised as a concern.[5] The assay has also been claimed to be unreliable because the GI is an average of highly variable responses among test subjects[6] and does not predict how an individual consuming the food will respond.[7]

At the present time, there seems to be little consensus on the application of the GI and the need to have all carbohydrate foods labeled to guide consumer choice. Indeed a recent consensus report concluded that, "As with all areas of science, a lack of data promotes controversy. Without new data it will be difficult to move beyond personal beliefs to knowledge in this important area of science."[7] The conflict in view arising from the application of the GI in treatment vs. prevention is also raised in the consensus report and reflected in the National Academy of Sciences summary report on the dietary reference intakes. It concludes that it is theoretically plausible "to expect a low GI diet to reduce the risk of Type II diabetes and cardiovascular disease. However, sufficient evidence needed to recommend substantial dietary changes based on GI is not available," as was stated four years ago in a review by Pi-Sunyer.[8] Recently, the American Diabetes Association[9] has also provided rather ambivalent statements about the utility of the glycemic index in diabetes management, which was the original goal of the concept of 30 years ago. It identifies the methodological problems with the index and highlights the variability in response of individuals to specific carbohydrate containing foods. The report also suggests that the potential role of converting from a high to a low-glycemic index and -glycemic load diets in management of Type II diabetes is modest at best.

Despite the lack of consensus, the use of the GI has expanded over the years and for the public it seems to resonate. However the merit of having a GI for every food seems to be a complex and an unjustified cost benefit in the goal of achieving public health application. Most individuals appear to consume a moderate glycemic index diet.[10,11] Thus, for the majority, dietary advice for the prevention of diabetes and cardiovascular

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Send comments or questions to:
The Soy Connection
P.O. Box 237
Jefferson City, MO 65102
Email: soy@communiqueinc.com

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disease should focus on controlling body weight. But the role of the GI in the prevention of obesity is uncertain. A recent publication[12] of a prospective cohort study found unconvincing evidence that there is an association between the GI or GL of habitual diets and obesity.[13] Whether or not sufficiently large, long-term, well-powered, randomized control trials will be conducted to improve understanding of the application of GI and GL to body weight regulations remains to be seen. Furthermore, the role of dietary advice based on the GI for the control of body weight is uncertain because adding education on the GI of foods did not improve treatment outcomes in a behavioral weight loss program.[14]

ABOUT THE AUTHOR

G. Harvey Anderson, Ph.D. is a professor of nutritional sciences and director of the program in food safety, nutrition and regulatory affairs at the University of Toronto. His research includes work on food intake regulation, food composition and chronic disease.

In the face of the uncertainty surrounding the benefits of the GI in dietary guidance, dietitians can be assured that promoting foods and eating patterns that reduce the rate of absorption of CHOs is unlikely to cause any adverse effects. Of course, a food that elicits a low glucose response may not be necessarily healthier because the food may be high in fat or low in nutrient content, but again this information is easily derived from food composition tables. As noted earlier there is sufficient data available to provide the practitioner with practical and general guidance on the glycemic response to carbohydrate containing foods and for the construction of diets and eating patterns that will contribute to a modest improvement in glycemic control in individuals that have been habitually consuming high GI and GL diets, or have Type II diabetes.

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See Page 7 for references of this article.

RESEARCH UPDATES

By Mark Messina, Ph.D.

Isoflavone Supplements and Hot Flash Alleviation: Is Genistein Content the Key?

More than 40 clinical trials have examined the impact of soyfoods, isoflavones derived from soybeans, or isoflavones derived from red clover on the alleviation of hot flashes. These trials have produced inconsistent results, although overall, they are suggestive of at least modest benefit. One problem in interpreting the scientific literature involving soy is that so many different products with varying chemical compositions have been used. To determine whether this may be a factor contributing to the inconsistent hot flash data, Williamson-Hughes *et al.* analyzed the results from 11 clinical trials in which isoflavone supplements were given to postmenopausal women.

The trials were divided into two groups according to the amount of genistein in the supplement. The total isoflavone exposure in the two groups was similar. In soybeans, the three isoflavones genistein, daidzein, and glycitein, comprise approximately 50%, 40%, and 10% of the total isoflavone content, respectively. However, the two primary processes for producing isoflavone supplements lead to products that vary greatly in genistein content.

One process produces a supplement that contains isoflavones that have a similar ratio to that found in soybeans whereas the other produces a supplement that is very low in genistein and high in glycitein. Of the six low-genistein supplements, only one trial reported a statistically significant decrease in hot flash severity or frequency whereas all five high-genistein supplements were efficacious. The cutoff between the high- and low-genistein supplements was 15 mg. These results suggest that at least for the alleviation of hot flashes, the specific type of isoflavone extract determines efficacy and that to derive benefit it is necessary to use one containing a sufficient level of genistein. *Menopause 2006;13:831-9.*

Isoflavones and Platelet Aggregation

There has been quite a bit of investigation of lipid-independent coronary benefits of isoflavones. There is, for example, suggestive but still very speculative evidence that isoflavones improve vascular reactivity. There has, however, been relatively little research of the effects of isoflavones on platelet aggregation. Excessive platelet aggregation plays a role in the pathogenesis of several cardiovascular disease events, including stroke and myocardial infarction.

Twenty-nine healthy postmenopausal women were invited to take part in a randomized study to receive either 100 mg/day isoflavone supplement (n=15) or identical placebo capsules (n=14). Blood samples obtained at baseline and after 12 weeks were analyzed for isoflavones, total cholesterol, high density lipoprotein cholesterol, triglycerides, glucose, insulin, estradiol, testosterone, gonadotrophins, sex hormone-binding globulin and platelet thromboxane A_2 receptor density. Blood pressure measurements, body mass index, subcutaneous fat at entrance and at the end of treatment were also registered. None of these factors were affected by isoflavones with the exception of platelet thromboxane A_2 receptor density, which declined significantly (from 181.9+/-30.9 to 115.2+/-16.2 fmol/10^8 platelets) in the isoflavone group, remaining mostly unchanged in the placebo group (176.3+/-27.3 to 170.4+/-28.2 fmol/10^8 platelets). Thromboxane A_2 initiates clot formation by first binding to receptors on platelets. Thus, the decrease in platelet thromboxane A_2 receptor density suggests isoflavones may decrease the tendency for blood clots to form, which may decrease coronary heart disease risk. *Maturitas 2006;54:270-6.*

SOYFOODS IN A LOW GI DIET

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GI AND DISEASE PREVENTION

Recent research suggests that following a low-glycemic diet not only helps to facilitate weight loss, but may also have a significant impact on disease prevention.[3,4] Elevated fasting blood glucose levels, altered insulin levels and elevated glycated hemoglobin are common markers of insulin resistance and Type II diabetes.[5] In a cross-sectional study of over 1,300 Japanese women, researchers assessed dietary GI and GL from food records and found that GI/GL positively correlated with BMI, fasting blood glucose levels, triglycerides and HbA1c.[6] In another study that examined associations among Type II diabetes and fiber, dietary GI and GL, and fiber-rich foods, researchers reported that high dietary GI and intake of white bread and starch were associated with an increased risk of Type II diabetes.[7]

Other studies have shown an association between consumption of a high-GI diet and increased risk of cardiovascular disease (CVD).[8] In a two-arm prospective clinical trial involving 53 postmenopausal women at risk for cardiovascular disease (CVD), subjects on a low GI diet that included a soy protein beverage showed greater improvement in total cholesterol, LDL cholesterol and triglyceride levels than subjects on a traditional low-fat diet.[9]

GI/GL OF SOYFOODS

Foods from the legume family often have low to moderate GI values. Soybeans have one of the lowest GI values of all the legumes (GI = 14-20), likely because of their higher protein and fat content.[2] As a result, many soy-based foods fit nicely into a low-glycemic diet. See Table 1 for the GI/GL values of some popular soyfoods.

Table 1 – GI/GL Values

Product	Glycemic Index		Glycemic Load		
Soyfoods	GI Value	GI Ranking	Amount	GL Value	GL Ranking
Soybeans	18	Low	5 oz.	1	Low
Soymilk	44	Low	8 oz.	8	Low
Soy yogurt (2% fat)	50	Low	7 oz.	13	Moderate
Soy smoothie (1% fat)	30	Low	8 oz.	7	Low
Other Foods					
Cornflakes	81	High	1 oz.	21	High
White rice, parboiled	75	High	5 oz.	28	High
Potato, baked	85	High	5 oz.	26	High
Bagel, white	72	High	½ bagel	25	High

Source: The Glycemic Index Table[2]

SUMMARY

There is a growing amount of evidence supporting adoption of a low-glycemic diet as a means to help manage blood glucose levels and reduce the incidence of obesity, Type II diabetes and CVD.[7,9] As researchers, dietitians and other clinicians continue to educate the public on the virtues of distinguishing between refined and complex carbohydrates, general awareness of the glycemic index will continue to rise. The unique composition of soy gives it a low GI ranking and makes soyfoods a good choice for a low-glycemic diet.

ABOUT THE AUTHOR

Michelle Babb, M.S. is a food and nutrition communications specialist with an interest in functional foods and nutritional therapy. She has worked with soybean farmers and researchers for the past six years and recently earned a master's degree in nutrition from Bastyr University.

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See Page 7 for references of this article.

GLYCEMIC GUIDELINES

By Michael Mansueto Leidig, R.D.

What is the glycemic index?

The glycemic index (GI) has been around for 25 years, but only recently has it come to the attention of consumers as a way to determine the healthfulness of carbohydrate-containing foods like vegetables, fruits, dairy, beans, soy, grains and cereals. The GI measures the rise in blood sugar after eating a particular food.

Why should I use the glycemic index?

A food's GI provides additional information about its healthfulness--like fat, protein, fiber and sodium do. Research suggests that consuming low GI foods may decrease risk for certain diseases such as heart disease, diabetes and obesity. So, it's a good idea to become familiar with low GI foods.

How do I make low glycemic index choices?

Most food labels do not list a GI, but you can follow these suggestions to easily lower the GI of your diet.

- Choose plenty of **vegetables**, but limit corn and potatoes
- Select **non-tropical** whole fruit instead of juice or tropical fruit like banana and pineapple
- Pick **unsweetened** yogurt, milk and dairy alternatives such as soymilk/yogurt over sweetened varieties
- Consume **balanced meals** containing carbohydrate, healthful fat and lean protein (chicken/turkey/tofu/fish) instead of meals based on carbohydrate alone
- **Replace refined grain** snacks such as candy, sweets, chips and crackers (even whole wheat varieties) with nuts, seeds, cheese/yogurt (milk-based or soy-based)
- Incorporate **beans**, barley, brown rice, oats, pasta (cooked al dente) and quinoa into meals more often than corn, couscous, potato and white rice
- Choose **oat-based** cereals with more soluble fiber (listed on the Nutrition Facts Panel) such as steel cut oats over corn, rice, or wheat-based cereals

ABOUT THE AUTHOR

Michael Leidig, R.D. is a research dietitian at Children's Hospital in Boston, where he helps coordinate glycemic index research. He also is the founder of Nutrition & Fitness Advisors, a one-on-one consulting service.

Thai Style Tofu and Brown Rice

By Paul Blakeslee, B.S.

Yield: 6 servings

Ingredients:

1 cup	Long grain brown rice
2 cups	Vegetable stock or water
8 oz.	Extra firm tofu, drained and cut into ½" inch cubes
2 tsp.	Soybean oil
2 tsp.	Sesame oil
1/4 tsp.	Fish sauce (optional)
Few pinches	Crushed red pepper
Pinch	Salt
Pinch	Ground black pepper
3 each	Green onions or scallions, chopped
3/4 cup	Red bell pepper, chopped 1/4" pieces
2 cloves	Garlic, chopped finely
1 Tb.	Fresh ginger, peeled and chopped finely

(May substitute 1/8 tsp. of ginger powder)

1/2 cup	Basil, chopped into ribbons
1/2 cup	Cashews
To taste	Soy sauce

Method of Preparation:

1) In a small bowl, combine tofu, soybean oil, sesame oil, fish sauce, crushed red pepper, salt and pepper. Mix gently with a large spoon so that the tofu is well covered with the other ingredients. Cover and put in the refrigerator to let sit until needed, up to 4 hours.

2) Add rice and stock to a medium saucepan. Bring to a boil and then reduce heat to low. Cover saucepan and simmer until done. (Around 40-50 minutes)

3) After rice is done, put a large sauté pan on over high heat. Wait until the pan gets hot before adding the tofu mixture.

4) Brown the tofu on all sides. Then add the scallions, bell pepper, garlic and ginger. Cook vegetables until tender (this will be quite quick- -approximately 2-3 minutes).

5) Add the brown rice to the pan and mix together with a wooden spoon. Let sit for 1 minute and then mix again. In this process, you are trying to get the rice crispy but not burned.

6) Lastly, mix in the basil, cashews and add soy sauce to taste.

Chef's Note: This dish is great served with steamed broccoli or mustard greens.

Nutritional Analysis: **Calories** 175; **Total Fat** 8.5 g; **Saturated Fat** 1.4 g; **Carbohydrates** 19 g; **Total Protein** 7.5 g; **Soy Protein** 4.2 g; **Cholesterol** 0 mg; **Dietary Fiber** 2 g; **Sodium** 465 mg.

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Jefferson City, MO 65102

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TAKING OUT TRANS

SOYBEAN OILS IN THE PIPELINE

By Lisa Kelly, M.P.H., R.D.

Soybean oil is by far the most widely consumed oil in the United States, representing about 75% of edible oil consumed domestically. Food manufacturers and foodservice operators select soybean oil most often due to its wide availability, neutral flavor, consistent quality and good nutritional profile. With few exceptions, home cooks reaching for their vegetable oil will find soybean oil as the sole ingredient if they check the label.

Today's soybean oil is low in saturated fat, virtually trans fat-free, an excellent source of omega-3 and omega-6 fatty acids, and a provider of vitamin E. Because of the large quantity of soybean oil consumed, it is the leading source of omega-3 fatty acids in the U.S. diet.

Innovations in plant breeding and food biotechnology allow seed technology companies to produce new seed varieties that will lead to healthier oils for human consumption. This pipeline of enhanced soybean varieties will generate oils with better nutritional profiles and product performance.

Taking the Trans Out: To remove trans fats from the food supply, new soybean oils have been introduced that do not require hydrogenation (the process that creates trans fats) for use in manufacturing and foodservice's frying applications.

- Low-linolenic soybean oil –- containing less than 3% linolenic vs. the traditional 7% -- offers an excellent alternative to partially hydrogenated vegetable oil. It is now commercially available.
- Oils with increased oleic content should be in the marketplace in two years for further health and functionality benefits.

Keeping an Eye on Sats: Along with trans fats, saturated fat reduction continues to be an important goal. Though soybean oil is not high in saturated fats, there is significant research underway on varieties with reduced saturates (at 7% or less vs. the traditional 15%), especially reduced palmitic fatty acid, considered one of the saturated fatty acids most detrimental to human health because it raises blood cholesterol levels to the greatest degree.

Omega-3 Opportunities: Another issue concerning cardiovascular health is the ratio of omega-3 fatty acids (found primarily in seafood) versus omega-6 fatty acids in the diet. Soybeans offer a plant-based source of omega-3 fatty acids called alpha-linolenic acid (ALA), and researchers are working to make soy even richer in these fatty acids. Although the majority of evidence that suggests omega-3 fatty acids reduce the risk of heart disease pertains to the longer-chain forms found in fish (EPA and DHA), the shorter-chain ALA may also have health benefits. The goal is to create an affordable, land-based, renewable source of omega-3s that makes it easier to create great-tasting products rich in this nutrient.

Scientific advancements have produced soybeans with traits differing from the commodity soybean. It is anticipated that advancements will continue in the lab and on the farm to produce ingredients and foods that will positively impact health.

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