

A lighthouse costs less than shipwrecks.



Prevention costs less than disease.

## The National Insulin Resistance Council

A not-for-profit disease prevention organization

### Energy and Nutrition

---

One of humanity's great truths is that we are what we eat. Yet there is nothing simple about what we eat. Diet is complex because of the variety of foods we can consume, the near total variability of when, how much and in what combinations we consume them and the effects of processing before they ever gets to us. All of that is still only part of the picture because any two people differ in the various measures of height, fitness and insulin response, to name a few, making each food's effect vary by individual response.

Is it any wonder that there is no sure-fire diet that works for everyone? Improved nutrition comes from knowing a set of concepts and putting them to use, one person at a time. We're not going to discuss the value of vitamins, minerals and balance among the nutrient groups like protein. In the context of *insulin resistance*, it is the energy aspect of food that matters. [Learn more about **Insulin Resistance** [here](#)].

As with fitness, there are numerous measures to evaluate and compare food energy content and impact. Up until recently, there has not been a single measure that tells you everything you need to know about the energy effects of different foods. Measures are evolving, however, and one, called *glycemic load*, holds extra promise. Before describing it, we'll cover a familiar concept, one myth, and relatively recent concepts.

The most familiar concept regarding food energy is that of *calories*. A calorie is a standard measure of energy for all fuels, not just food, and allows different sources to be compared. Technically, a cup of gasoline has a certain number of calories, but our bodies cannot convert that particular fuel to energy. The body gets all its fuel from food, and everything one might eat can be, and probably has been, measured for how much energy it contains. Every packaged food is labeled to define a "serving" and how many calories are in one. The calories come from the sugars, simple and complex, that are in the food. Together, all the sugars are the carbohydrates, or carbs, in the food, and the number of grams of carbs is also shown on that label. Imagine a label for a single 7.5" carrot. It would tell you that one carrot is a "serving" and one serving yields 30 calories from the sugars in its 7 grams of carbohydrates.

The fuel stored in your body certainly has caloric value, and you add to or deplete that value routinely by digesting new food and burning fuel daily, sometimes more, sometimes less. Even asleep, we burn calories to breathe, maintain body temperature and to roll over occasionally. Over time, if you burn more calories than you consume, you lose weight as you consume stored energy. Calories are in nearly all foods, but in wildly differing amounts.

Calories within food are embedded in an array of chemicals that get taken apart during digestion. Digestion takes some chemicals apart better than it does others. And equal weights of various chemicals, even sugars, yield differing amounts of calories. In some cases, all of a food's

calories are retrieved, while in others, much of that food's caloric value is passed as waste. The fact that a food container is labeled as having so many calories per serving does not relate to what is actually consumed. For example, the nutrition label on a bag of tortilla chips says that a "serving" is 19 chips and contains 150 calories. Few people probably count chips as they eat, so the calories consumed will hardly be exactly 150. Furthermore, only very expensive metabolic testing can accurately tell how many calories a person burns. Because of such factors, calorie counting is a pretty rough weight management tool, though better than nothing.

A tenacious myth about diet is that our body fat comes from the fat we eat. No matter what we eat, it is all broken down into base chemicals during digestion. Then our body uses the base chemicals to make whatever new chemicals it needs. Carbohydrates and complex sugars are broken down into simple sugars, for example, glucose being the main one. Fat we eat is broken down into sugars and a group of chemicals called lipids. The body either uses glucose as fuel or the liver converts it into a chemical called glycogen. Glycogen can be stored in two places. The liver stores nearly a pound of it. The rest is circulated where it is picked up by adipose cells. Concentrated in groupings around the body, those cells loaded with glycogen constitute our body fat. Eliminating all dietary fat but still getting an excess of calories from other foods will result in even more body fat. Weight management can only be achieved by limiting total calories, not just by limiting a particular source of them. If you need evidence for this, check the calories on fat-free ice cream.

Another measure of food energy has been around for almost two decades, but many people are still not familiar with it, though it is well established scientifically. This measure is called the **glycemic index** of a food and it represents the quality of a food's carbohydrates. That quality, or chemical makeup, determines how fast glucose is released from the food during digestion. That rate of glucose release is important because it determines the rate of insulin production that results.

Nearly all calories that we use enter the body in the form of the simple sugar glucose. Foods can differ in both how much carbohydrates (their total of sugars in various forms) and in the composition of those carbohydrates. Some foods, like pasta and bread, store energy in very complex carbohydrates called starches. Other foods, like many juice fruits, store them in sugars only. It turns out that the caloric value of two foods can be the same and the amount of carbohydrates can also be the same, yet the glucose they generate can differ widely. In addition, some foods, because of chemical complexity, deliver their calories slowly and others do so very quickly. The ease of digesting down the chemicals in their carbohydrates is a factor that determines how quickly glucose enters the blood.

The rate of glucose deliverance from a given amount of a food creates an insulin response. The faster the glucose arrives, the more dramatic the insulin response. The **glycemic index** indicates how much glucose 50 grams of a food's carbohydrates produces compared to a standard. The initial version of glycemic indices compared all foods to 50 grams of pure glucose, which was said to have an arbitrary index value of 100. More recently, 50 grams of the carbohydrates in white bread has become the standard also adopting the index value of 100. Should you compare the glycemic indices of two foods, be sure they refer to the same standard.

While interesting scientifically, **glycemic index** has only limited practical use. The measure has two problems. One is that typical serving sizes of most foods don't have 50 grams of carbs in them. Three slices of white bread only have 45, and you would have to eat seven carrots or two whole apples to consume 50 grams of their carbs. The other is that glycemic indices are mainly helpful only when comparing similar foods. For example, a slice of white bread's glycemic index of 100 can be compared meaningfully to a slice of rye bread's 58. They

both contain about the same amount of carbohydrates, so one can expect the white bread to generate a considerably higher insulin response than the rye bread would. Knowing that carrots glycemic index is 131 and white bread's is 100 doesn't tell you enough. Can you make a salad with bread instead of carrots?

The reason **glycemic index** is important is that it is a way of predicting insulin response. Recall that higher insulin levels in the blood signal the liver to make and store energy in the form of glycogen. A higher insulin response creates more aggressive fat creation. A higher glycemic index means easier fat accumulation.

In addition to limiting total calorie consumption, good weight management should emphasize low, and limit high, **glycemic index** foods. More detailed explanations and the index numbers of many tested foods are available in books including *The Glucose Revolution* by Brand-Miller, Wolever, Colagari and Foster-Powell, and on Internet web sites including the American Journal of Clinical Nutrition's fairly complete table of values at <http://www.ajcn.org/cgi/content/full/76/1/5/T1>.

In 1997, Dr. Walter Willett and his associates at Harvard's School of Public Health demonstrated the concept of **glycemic load**. Less well known than glycemic index, **glycemic load** is far more useful as it is a direct measure of the energy density of food and allows for direct comparisons between foods, similar or not. **Glycemic load** is derived by mathematically combining a food's glycemic index, a measure of how fast glucose is obtained from that food's particular mix of chemicals, with the actual amount of digested glucose generated from of a given amount of that food. It is calculated as  $GL = GI/100 \times \text{Net Carbs}$  where GI is glycemic index and net carbs are total carbohydrates less dietary fiber in a "serving" of a logical weight. You can roughly estimate energy density alternatively by comparing a food's calorie content to its weight. But **glycemic load** reduces this value to a single number. One would hope that the FDA will require this number to appear on food package nutrition labels, given its extraordinary utility.

Not only can you compare even dissimilar foods by knowing **glycemic load** numbers, you can combine the effects of multiple foods and assess the impact of a whole meal without needing a supercomputer. A fairly complete list of hundreds of foods and their glycemic load values are at <http://www.ajcn.org/cgi/content/full/76/1/5/T1>. With just two measures, **glycemic load** and actual calorie content for the amount of food consumed, people can much more easily manage both insulin response and total energy intake while getting the nutrition they need, a promising path to good eating and better lifestyle.

The goal of the National Insulin Resistance Council (NIRC) is to **prevent** millions of non-infectious disease cases tied to **insulin resistance** including diabetes, heart failure, stroke and recently-linked Alzheimer's. It sponsors, operates, and collaborates with others on programs that lead to **early identification** of affected individuals and fosters targeted **active prevention** programs.