Carbohydrate Quality: Who Gets to Decide?

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Defining Carbohydrate Quality

We all want quality—whether in our cars, our food, or our footwear. So, why not demand quality carbohydrates? The first question we must ask, however, is quality carbohydrates for whom?

In the United States carbohydrate recommendations are given in the Dietary Reference Intakes (DRIs) (5). The recommended dietary allowance (RDA) for carbohydrate is 130 g/day for adults and children aged 1 year or older. This recommendation is based on the amount of sugar and starches required to provide the brain with an adequate supply of glucose. The DRIs also include an acceptable macronutrient distribution range (AMDR): for carbohydrate the recommended range is 45–65% of total calories.

Sugars and starches provide glucose, the main energy source for the brain, central nervous system, and red blood cells. Glucose also can be stored as glycogen (animal starch) in the liver and muscles or, like all extra calories in the body, can be converted to fat. Dietary fibers are nondigestible forms of carbohydrate. Dietary fibers that are intrinsic and intact in plants help provide satiety and aid in laxation. Diets that are high in dietary fiber protect against several chronic diseases, especially coronary heart disease (CHD). In fact, the DRI for dietary fiber intake (14 g/1,000 kcal) is based on the protection dietary fiber has been shown to provide against CHD in large prospective cohort studies (5).

The energy content of digestible carbohydrates, which include sugars and starches, is 4 kcal/g. Carbohydrates that are not digested and absorbed in the upper gastrointestinal tract and not broken down in the colon (i.e., dietary fiber) are considered to yield no energy to the body. Thus, insoluble fibers are considered to provide no calories. Soluble dietary fibers may be fermented by the gut microbiota and yield short-chain fatty acids (SCFAs) in the gut. Because it yields SCFAs, fermentation of soluble fibers in the gut provides 2 kcal/g to the body.

Dietary guidance is based on the requirements of healthy adults who do not have diseases that require dietary restrictions. Thus, general dietary guidance, by design, must be broad and nonspecific. Conversely, advice can be given on specific foods, food groups, dietary patterns, and nutrients. Each of these approaches has its strengths and limitations. Even if we focus on high-quality carbohydrates for general dietary guidance, we must first determine what metrics to use to define what is a high-quality carbohydrate.

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Carbohydrates can be divided into food groups or chemical entities or by how they function in the body. Over time these divisions have shifted and created confusion in the carbohydrate field.

Certain high-carbohydrate foods are promoted in dietary guidance. For example, consumption of fruits and dairy products that are high in sugar and of grains, vegetables, and pulses that are high in starch and fiber is recommended. These starchy foods also contain protein, fat, vitamins, and minerals, which support their inclusion in dietary patterns.

Another categorical division for carbohydrates is based on chemical structure. Digestible carbohydrates can be divided into sugars and starches.

Sugars. Sugars in the diet are generally disaccharides such as sucrose or lactose (4). These sugars can come from recommended foods, including fruits and dairy products, or they can be added to food products as isolated sugars from sugarcane and sugar beets or as hydrolyzed starches from corn and other grains. Added (extrinsic) sugars are a source of extra calories in the diet, and dietary guidelines around the world recommend consumption of less added or extrinsic sugar (4).

Using these recommendations as a guide, grouping foods based on intrinsic versus extrinsic sugars sounds like a fair system for evaluating carbohydrate or sugar quality. However, other issues may cloud this grouping system. Dairy foods such as milk or yogurt contain intrinsic sugars but may also contain extrinsic sugar (e.g., chocolate milk or flavored yogurt). In addition, many systems for assigning intrinsic sugars do not include fruit juices, while others maintain that fruit juices do not count as added sugars as long as they are not used for sweetening purposes (4). Although fruit juices may contain the same amounts of vitamins and potassium as their whole fruit varieties, they also may be overconsumed in certain population groups. So, should fruit juices be listed as sources of "quality carbohydrate," or should they only be considered sources of "quality carbohydrate" if consumed during appropriate eating occasions and in appropriate amounts?

Further complicating recommendations, sugars provide properties in food product formulations beyond simply taste (1). As a result, strict rules for sugar removal from product formulations will affect not only flavor, but food safety, storage, and quality as well. Thus, removing added sugars from foods presents many challenges. There is also the question of whether alternatives to added sugars are always higher quality carbohydrates? The answer is not necessarily. Furthermore, many alternative sweeteners are not carbohydrates, so where do they fall on a list of "quality carbohydrates"?

Starches. Starches are long carbohydrate chains of glucose that are readily digested and absorbed. Glycemic response for starches is typically faster than for sugars because glucose is more readily absorbed than fructose from sucrose. Thus, although consumers talk about a "sugar rush," a "starch rush" might be a more appropriate way to think about glycemic response. Of course, not all starches are the same: long-chain amylose is more slowly digested and absorbed than branched-chain amylopectin. Animals, including humans, store glucose in their muscles and liver in the form of glycogen (animal starch). This glucose provides quick energy as needed but is in short supply in the body.

Starches can also be resistant to digestion and absorption in the body. Resistant starches can occur naturally in foods (e.g., raw bananas) or can be produced by chemical or other processing techniques to make a starch resistant to digestion and absorption. Further, certain varieties of corn (e.g., high-amylose corn) are higher in resistant starch than others. Although resistant starch may differ from dietary fiber in some of its properties, it is typically included as dietary fiber on food labels.

Dietary Fiber. Another way to assess carbohydrate quality is digestibility and absorption. Dietary fibers are not digested and absorbed in the gut but may be fermented in the large intestine. This fermentation process produces SCFAs, lowers gut pH, and alters the gut microbiota. All of these changes may have health benefits (7).

Too much fermentation in the gut, however, can cause intestinal gas and other symptoms that are unacceptable to consumers (2). A common challenge in promoting a high-fiber diet is the common consumer perception that it will cause intestinal gas.

Methods to measure the fate of different dietary fibers in the body are quite limited. So, although we can measure the fiber content of a food product, it is not possible to define one biomarker for testing the physiological effect of fiber in the gut. We know that dietary fibers play a role in the prevention of heart disease and diabetes and in bowel health, but because fibers differ widely in their effects in the body, we have no universally accepted biomarker to test for the effects of fiber in the human body.

In the United States, health claims (i.e., disease risk reduction claims) are allowed for oat bran, barley bran, and psyllium based on their ability to lower serum cholesterol levels. There is scientific consensus that these fibers have health benefits. Many fiber supplements are also accepted as laxatives that can be purchased without a prescription, yet we have not identified a biomarker that can be used to document that fibers play a role in bowel health.

In providing recommendations for carbohydrates and carbohydrate quality, we will no doubt continue to use a combination of chemical attributes, including total carbohydrate, sugars, and dietary fiber, while moving toward identifying more attributes based on what happens to the carbohydrate in the digestive tract. This also has applications for low-digestible carbohydrates (carbohydrates that are incompletely or not absorbed in the small intestine but are at least partly fermented by bacteria in the large intestine), such as polyols (2). For example, low-digestible carbohydrates may be quality carbohydrates for consumers who need more fiber in their diet, but may not be quality carbohydrates for patients with irritable bowel syndrome (IBS).

Prebiotics might also be listed as quality carbohydrates (7). A prebiotic is a substrate that is selectively utilized by host microorganisms and confers a health benefit. Most prebiotics are carbohydrates (i.e., dietary fibers) and should be considered candidates for designation as "quality carbohydrate."

Ways to Help Consumers Select Quality Carbohydrates

One role of dietitians is to design diets that provide specific information about the carbohydrate load of a diet. Useful tools exist, including the carbohydrate exchange system, that provide information on the digestible carbohydrate, from sugar or starch, that is provided by the exchange of a food. This system is known as carbohydrate counting and is an essential tool used by diabetics to control their blood sugar by monitoring their intake of digestible carbohydrates. Using carbohydrate exchanges to control digestible carbohydrate intake works well because different food groups provide different amounts of digestible carbohydrate. For example, each starch serving (e.g., $^1/_2$ cup of pasta, $^1/_2$ cup of potatoes, 1 slice of bread) provides 15 g of carbohydrate. Each

fruit serving (e.g., 1 small apple, peach, or pear or 1/2 banana) provides 15 g of carbohydrate. Each milk serving (e.g., 1 cup of milk or yogurt) provides 12 g of carbohydrate. Vegetables, except for starchy vegetables, are low in carbohydrate, with a 1/2 cup of cooked vegetables or 1 cup of raw vegetables containing 5 g of carbohydrate. It might be argued that this system only provides information on carbohydrate quantity, not quality, but it is noteworthy that all of these foods are included in dietary guidance.

Perhaps the first way to insert quality into the equation is to select foods that are higher in dietary fiber. Fiber recommendations on the revised Nutrition Facts panel list 28 g of fiber as the recommended amount in the U.S. diet, based on fiber recommendations for 2,000 kcal/day (14 g/1,000 kcal). Fiber intake in the United States currently is only about half the recommended levels, so to support carbohydrate quality, we should support choosing recommended foods with the highest fiber contents. Recommendations for grains (6), pulses (3), and vegetables and whole fruits (8) would increase both the fiber content of the diet and its carbohydrate quality.

Carbohydrate-rich foods are also the most sustainable foods in our diets and the least expensive. In addition to fiber, recommended carbohydrate-rich foods supply other nutrients. Dairy foods provide calcium, vitamin D, and high-quality protein—nutrients that are lacking in many U.S. diets. Fruits and vegetables provide potassium, which is another nutrient of concern in U.S. diets. Whole grains provide minerals and vitamins.

Because grains are relatively inexpensive, widely consumed, and stable when nutrients are added, they were a logical choice for nutrient additions in the U.S. diet. Enriched grains provide iron, thiamin, riboflavin, and niacin, and since 1998, refined grains are also fortified with folic acid, which is well absorbed and important for the prevention of neural tube defects.

Societies around the globe have incorporated carbohydrate staples as the foundations of their diets. Whether it is potatoes in Ireland, pasta in Italy, corn tortillas in Mexico, rice in Asia, or bread in France, we have all long-appreciated that carbohydrate-based staple foods are the foundation of our diet and should be promoted in dietary guidance for the masses.

Many clinical conditions require that individuals restrict carbohydrate intake to promote beneficial health outcomes. For example, lactose intake must be restricted for those with lactose intolerance, while diabetics must use carbohydrate exchange lists to monitor their digestible carbohydrate intake. Carbohydrates are often restricted in weight-loss diets—both as a means of cutting calories and to assist in more rapid weight loss. On the flip side, athletes consume large quantities of digestible carbohydrates to fuel their activities. Thus, carbohydrate recommendations must be tailored for the person and lifestyle and to address individual nutrition needs.

For healthy individuals, other proposed methods for rating "carbohydrate quality" provide more challenges than opportunities. For example, "net carbs" are often promoted in diabetes education. In this exercise consumers are instructed to subtract fiber amounts from total carbohydrate amounts to yield a net carb amount. Despite all efforts to provide factual information on the Nutrition Facts panel, total carbohydrate is determined "by difference," so this calculation for net carbs is likely not a good predictor of carbohydrate response.

Another example is glycemic index (GI) and glycemic load (GL), which have been used to predict health outcomes in epidemiological studies. Because fructose is more slowly absorbed than glucose, foods that are high in sugar have a lower GI, but they are not promoted in dietary guidance. Additionally, GI measurements are performed on individual foods. Because foods are generally eaten as mixtures, an individual GI may not be helpful. Thus, GI may be helpful in defining blood glucose response for diabetics but may not be helpful for delivering high-quality carbohydrates for other consumers.

Bottom Line on Carbohydrate Quality

We all want to be quality individuals and to consume quality carbohydrates. At the end of the day, however, our best measures for carbohydrate quality must be based on consuming an optimal quantity of digestible carbohydrates and making selections from the recommended food groups—whole grains, pulses, vegetables, nuts, fruits, and dairy. Within each of these food groups, high-fiber foods should be chosen often. Despite efforts to improve carbohydrate quality by promoting high-fiber foods, fiber intakes continue to be lower than recommended levels. Thus, different strategies to increase fiber consumption without increasing calorie consumption must be devised and delivered to consumers.

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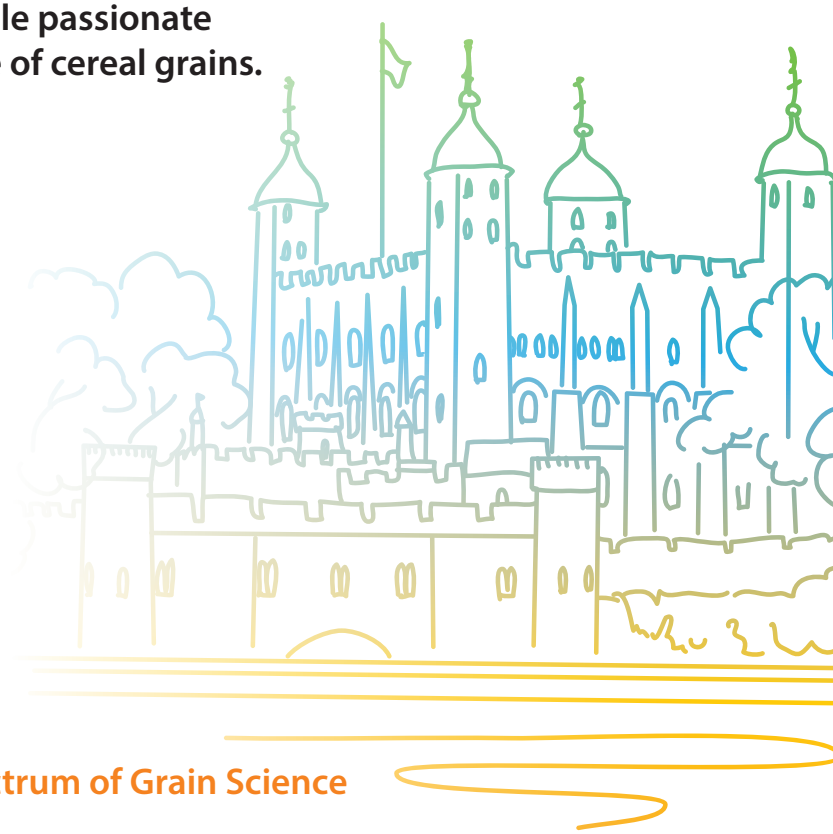

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