

Glycemic Response Definitions

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Glycemic (Net) Carbohydrate Definition Committee



The AACC International Board of Directors appointed an ad hoc Glycemic (Net) Carbohydrate Definition Committee at the annual meeting in September 2004. The committee was charged “to provide a measurable definition that will enable manufacturers to communicate the glycemic response in grams per serving of food.” The purpose of the work was to create a level playing field for manufacturers and to provide consistent

information that would assist consumers in better understanding how the carbohydrate content of a given food affects blood glucose levels.

The effort was undertaken as interest in glycemic response was steadily increasing in segments of the consumer community. However, it also is apparent that the concepts of glycemic response and its usefulness in affecting health outcomes, as well as the numerous label terms on food packages, only created more consumer confusion.

The lack of agreement on the health importance of measures of glycemic response and need for consistency on food package labels worldwide made it apparent to the committee that its first task was to provide some consistent definitions. Vigorous discussions, with at times diametrically opposed opinions, ensued. After nearly two years of conference calls, discussion, debate, and input from many sources, the ad hoc committee recommended definitions for available carbohydrate, glycemic response, glycemic carbohydrate, and glycemic impact.

The definitions are given below, with explanatory comments.

Available carbohydrate is carbohydrate that is released from a food in digestion and that is absorbed as monosaccharides and metabolized by the body.

This definition is very similar to that proposed by the FAO.¹ The committee decided that “**net carbohydrate**” is equivalent to “available carbohydrate.” A definition of “net carbohydrate” was

not included because that term is used mostly in North America and not widely used or considered in other parts of the world. It is also important to note that, in many parts of the world, “available carbohydrate” and “dietary fiber” (unavailable carbohydrate) are given on the nutrition label as separate items. This is unlike the practice in North America, where the carbohydrate number on the nutrition facts panel is “total carbohydrate,” i.e., the sum of available carbohydrate and dietary fiber (Fig 1).

This definition would obviously include such readily absorbed components as glucose and fructose. These may have occurred in the food as such, or as more-complex molecules such as starch, maltodextrin, and sucrose that were digested to deliver these monosaccharides. The committee also recognized that some carbohydrates are only partially available due to the nature of the food matrix, degree of cooking, or the nature of the carbohydrate itself—such as the resistant component of starch and certain polyols.

Glycemic response is the change in blood glucose concentration induced by ingested food.

This definition was agreed upon by all. It was noted that the definition must include the words “ingested food” because attributes of the food (such as the amount of food, the amount of cooking, the ripeness of the food, or the amount of fat or protein in the food) can affect the glycemic response.

Glycemic carbohydrate is carbohydrate in a food that elicits a measurable glycemic response after ingestion.

This definition reflects the fact that not all carbohydrate elicits a glycemic response.

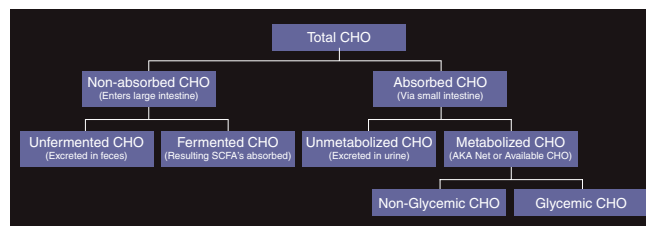


Fig. 1. Carbohydrate schema that guided AACC International committee discussions. “Net CHO” includes all CHO (and other unaccounted for food components) minus dietary fiber. “Net CHO” falls under the category “Absorbed CHO.” “Available CHO” falls under the category “Metabolized CHO.” (Courtesy Stephen Brooks, Health Canada)

¹ This can be found online (http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/Y5022E/y5022e03.htm).

Glycemic impact is the weight of glucose that would induce a glycemic response equivalent to that induced by a given amount of food.

This definition was guided by the realization that the amount of food can change the glycemic response. Some measures, such as the glycemic index, use 50 g of available carbohydrate compared to 50 g of glucose. For some foods, such as carrots, the amount of food needed to reach the 50-g equivalent is not in a range that would customarily be eaten. Thus, the glycemic index measure might induce consumers to avoid healthful foods such as carrots and choose foods such as chocolate cake with icing, which have a low glycemic index.

The committee was guided in its deliberations by the belief that, to be used by the food industry and in nutrition education, a definition must refer to a measurable quantity; i.e., a recognized analytical methodology must exist or be developed to determine the defined properties or responses with both accuracy and precision. The proposed definitions represent *in vivo* responses to food ingestion and are determined via carbohydrate concentration in the blood and/or degree of excretion from the body via feces or urine. A common measure of availability is postprandial blood glucose concentration—**glycemic response**. Those carbohydrates that elicit a glycemic response after ingestion are **glycemic carbohydrates**. However, when consumers and popular authors talk about glycemic carbohydrates, they are usually referring to carbohydrates that cause a marked rise in blood glucose immediately after ingestion. Individuals with normal glucose tolerance can rapidly clear this glucose from the bloodstream. Thus, use of “glycemic carbohydrate” can lead to misinterpretation, since often it is meant to refer only to carbohydrates with a high glycemic response and not to carbohydrates that merely possess the capacity to induce a glycemic response.

Glycemic carbohydrates in a food, as defined here, will differ in the extent of their postprandial glycemic effects, e.g., the response to fructose is about 20% of that to glucose. The committee therefore developed a definition for **glycemic impact** as a means to quantify the expected relative effect that a food would have on postprandial glycemic response. This definition can ultimately meet the charge of the committee “...to communicate the glycemic response in grams per serving of food.”

The currently available method of quantifying the relative degree of glycemic response to a food involves measuring the incremental area under the blood glucose response curve after ingestion of the food and comparing it with the response to a specified amount of a glucose reference in the form of glucose or starch in white bread. However, there is considerable intra- and inter-individual variability in such measurements, which can lead to large standard deviations and ultimately to disagreement regarding the validity of a number (value) that might be put on a food label. The committee recognized that it is very important to have agreement on recognized, validated analytical methods to measure the quantities defined.

Besides the above-noted variability from using humans, *in vivo* measurement is expensive for the routine food analysis necessary for nutrition labeling. Thus, the committee was concerned as to whether the proposed definitions could be measured either accurately or cost effectively with currently available methodology. The committee, therefore, recommends that a concerted effort be made to develop validated *in vitro* methodology that accurately mimics *in vivo* behavior to support these definitions. For perspective, a similar issue was addressed for dietary fiber in the past. It involved the major portion of “non-digestible” or “unavailable” carbohydrate. An *in vitro* assay was developed to support food labeling because an *in vivo* assay would be imprac-

tical. Interestingly, the fiber definition and methods of analysis have continued to evolve. We anticipate the same will happen with these proposed definitions and methods.

Finally, as part of the many discussions on the definitions, there was heated discussion about the usefulness of the concept of glycemic impact (as measured using physiological markers similar to that for glycemic index) as a help in selecting foods and diets for various conditions. There was some agreement that a diet with a low glycemic impact might aid diet selection for those with insulin resistance or type 2 diabetes mellitus. However, scientific agreement is lacking on the role of glycemic index *per se* or of glycemic load and any other health implications. Concern stems from the availability of only a few randomized clinical trials linking health and disease outcomes of the glycemic index *per se*. Also, the conflicting epidemiological evidence suggesting that diets of low glycemic index reduce the risk of diabetes and heart disease or lead to improved weight control fuels the confusion. Variability in study outcome could be due in part to differences in the diets that are unrelated to glycemic index or glycemic load alone. Often the diets are markedly different in amounts of total fat, protein, dietary fiber, and micronutrients. Diets showing the more-positive health impacts typically are most similar to the current recommendations for healthy eating (*Dietary Guidelines for Americans 2002* and *My Pyramid, Canada’s Food Guide to Healthy Eating* or those guidelines recommended by other government and health-promotion organizations worldwide).

The vigorous discussions of the committee regarding the usefulness of glycemic impact in health promotion and the validity of the measurement reflect discussions in the scientific community worldwide. Further research and more debate are needed in defining, measuring, and expressing the glycemic response to foods and in using this measure in selection of diets that promote health.

In summary, the committee recommends that the AACC International Board of Directors:

1. Adopt the definitions for “available carbohydrate,” “glycemic response,” “glycemic carbohydrate,” and “glycemic impact” developed by the committee.
2. Urge caution in their use for labeling and other aspects until effective *in vitro* measurement systems have been developed and health outcomes have been clearly established and agreed upon by the scientific community.
3. Create an AACC International Task Force, perhaps via the Dietary Fiber and Starch Technical Committee, charged to develop the new *in vitro* methods.

Members of the ad hoc Glycemic (Net) Carbohydrate Definition Committee:

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Stuart Craig (Danisco, U.S.A.)
Jon DeVries (Medallion Labs, General Mills Inc, U.S.A.)
Janine Higgins (University of Colorado at Denver and Health Sciences Center, Denver, CO, U.S.A.)
Julie Jones, Chair (College of St. Catherine, U.S.A.)
Betty Li (USDA [retired], U.S.A.)
David Lineback (University of Maryland, U.S.A.)
John Monro (New Zealand Institute for Crop and Food Research Ltd.)
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