Simple Sugars versus Complex Carbohydrates

The term carbohydrates includes monosaccharides and disaccharides, which are sometimes called simple sugars; and polysaccharides, which are sometimes called complex carbohydrates or starch, and fiber.

The term monosaccharide means one sugar molecule. Foods contain three common monosaccharides:
- Glucose
- Fructose
- Galactose

The term disaccharide means two sugar molecules. Two monosaccharides combine to form a disaccharide. Three important disaccharides are:
- Maltose = Glucose + Glucose
- Sucrose = Glucose + Fructose
- Lactose = Glucose + Galactose

The term polysaccharide means many sugar molecules. Dietary polysaccharides contain hundreds of sugar molecules and include:
- Complex carbohydrates or starch
- Fiber

Simple sugars and complex carbohydrates or starches occur naturally in many foods that also supply other nutrients, including milk, fruits, vegetables, breads, cereals, and grains. Sugars also are added to foods during processing and preparation. Most sugars found naturally in foods or added to foods are disaccharides, or two sugar molecules. The body cannot tell the difference between naturally occurring and added sugars because they are chemically the same.

Our bodies can only absorb monosaccharides, or single sugar molecules. During digestion enzymes break down disaccharides into two monosaccharides, which can be absorbed by the body. Digestive enzymes also break down complex carbohydrates or starches, which contain hundreds of sugar molecules, into monosaccharides or single sugar molecules for absorption. The body cannot tell the difference between monosaccharides that come from the breakdown of a simple sugar or from a complex carbohydrate.

Caloric Sweeteners

Caloric sweeteners include many regular sugars including: refined sugars, corn sweeteners, dextrose, high fructose corn syrup, honey, syrups, crystalline fructose, lactose, invert sugars, glucose, maltose, and concentrated fruit juices.

Sugars have several important roles in foods. For example, they give foods sweetness. Besides improving the flavor of foods, they improve the texture and color of baked goods. Sugar also helps to thicken, firm, or preserve foods such as puddings, jams, and jellies.

The main function of sugars (and all carbohydrates) in the body is to provide energy. Energy does indeed, “keep us going.” It is necessary for good health, growth, and proper body function and activity. Foods in the USDA MyPlate food groups that contain natural sugars supply energy and also provide important vitamins, minerals, protein, and fiber. Sugar by itself and foods high in added sugar, supply calories, but do not provide the added bonus of other nutrients.

Intake of Added Sugar

The Dietary Guidelines recommend people choose and prepare foods and beverages with little added sugar and that total added sugars be limited to 10 percent of total calories. Most added sugar in the diet comes from regular soft drinks and table sugar. However, baked goods, fruit drinks, dairy desserts, candy and ready-to-eat cereals also provide substantial added sugar to the diet.

Health Effects of Sugars

Nutritional Deficiencies

In excess, sugar can contribute to nutritional deficiencies by supplying calories without providing nutrients. Bakery items, candies, and soft drinks provide calories with few nutrients. Honey does provide a few vitamins and minerals, but the amounts are very small. On the other hand, grains, vegetables, fruits, and dairy foods contain natural sugars and starches, but also protein, fiber, vitamins, and minerals. Sugar can contribute to nutrient deficiencies only by displacing nutrients.

For nutrition sake the appropriate attitude to take is not that sugars are “bad” and must be avoided, but that nutrient dense foods must come first. The goal is good nutrition and moderation. The amount of sugar a person can afford depends on how many calories are available beyond those needed for nutrients.
Tooth Decay
In excess, both sugars and starches can contribute to
tooth decay. Both sugars and starches begin breaking down
to glucose in the mouth. Bacteria in the mouth ferment sugars
and in the process produce an acid that can dissolve tooth
enamel. Many factors are involved such as how long foods
stay on the teeth, how often foods are eaten, and dental hy-
giene. Overall, the risk of dental caries increases with intake
of nutritive sweeteners; however, sugars and carbohydrates
do not work independently from other factors such as oral
hygiene and fluoridation. For most people good oral hygiene
will prevent dental caries.

Diabetes/Hypoglycemia
The influence of food on blood glucose has led to the over
simplification that food controls blood glucose concentra-
tions. Foods do not, the body does. In some people, blood glucose
controls fail. When this occurs diabetes or hypoglycemia can
develop. Glucose may be modified as part of the manage-
ment, but hormonal regulation or obesity (in the case of type
2 diabetes) is the cause not glucose.

Hyperactivity or Misbehavior in Children
Controlled studies have failed to show an adverse relation-
ship between sugar and hyperactivity or misbehavior in
children, even in children who by report are sensitive to sugar.
The mechanism by which carbohydrate, including sugars, may
affect mood is uncertain, but may involve the production and
release of serotonin in the brain. High carbohydrate intake
stimulates the brain production of serotonin, which actually
can make a person sleepy.

Heart Disease
Usual intakes of sugar do not increase blood triglycerides
in most persons, provided calories are in balance. However,
a small percent of people are carbohydrate sensitive. These
people respond to high amounts of sugar or carbohydrate with
abnormally high insulin, which promotes triglyceride forma-
tion, which can increase heart disease risk. However, it is
important to keep the effects of sugars in perspective. Other
dietary factors such as saturated fat, trans fat, and obesity
have a much stronger association with heart disease than
sugar intake.

Obesity
Obesity is a complex issue and cannot be attributed to
one factor. Excess body fat arises from energy imbalance
coupled by taking in too many calories and by using too few.
Because sugar adds calories to foods and beverages, it has
been suggested that sugar has a role in causing obesity. Re-
search does not support a direct connection between sugar
and carbohydrate intake with obesity, unless excess intake of
sugar containing foods leads to excess calories and weight
gain.

Sugar on the Food Label
Sugars added to foods are listed in the food ingredient list.
The Nutrition Facts Panel on the food label lists the grams of
added sugar per serving of food under Total Carbohydrates.
The following terms are used on food labels to describe the
sugar content of foods:

• Sugar Free: Less than 0.5 g sugar/serving.
• Reduced Sugar: The sugar content of the product has
  been reduced by at least 25 percent.
• No Sugar Added: No sugar or any other ingredient con-
  taining sugar added to product.

Healthy Choices to Lower Sugar

Grain Group
• Many commercial bakery items are high in sugar. Look at
  the Nutrition Facts Panel to compare the sugar content
  of bakery items.
• Ready-to-eat cereals vary in sugar content. Read the
  Nutrition Facts Panel to compare the sugar content of
  cereals. The grams of sugar per serving is both sugar
  added by the manufacturer and naturally occurring sugar
  in fruits such as raisins and dates.
• Add fresh fruit or raisins to plain ready-to-eat breakfast
  cereals instead of sugar.
• Use yeast breads instead of sweets for the holidays. There
  is a variety to choose from and they use less sugar than
  traditional holiday treats.
• Gradually decrease sugar in recipes by one-quarter to
  one-third the amount called for in baked items as long
  as the product is acceptable. Bring out the sweetness
  with vanilla, lemon, or almond extract.
• Use fresh fruit toppings or unsweetened applesauce for
  pancakes, waffles, and French toast instead of syrup or
  honey.

Fruit and Vegetable Groups
• Fruits canned in light syrup or natural juices have less
  sugar than fruits canned in heavy syrup.
• Use fruits instead of sugar to sweeten other foods such
  as breads, cereals, desserts, and main dishes.

Protein Foods Group
• Try making your own breading and coating mixes for meat
  and poultry. Some commercially prepared ones contain
  more than 50 percent sugar.
• Grind your own peanut butter (many grocery stores now
  have machines for this) or look for peanut butter without
  added sugar.

Dairy Group
• Choose yogurts with non-caloric sweeteners.
• Choose frozen dairy desserts, including ice creams, frozen
  yogurts, and ice milks with non-caloric sweeteners.

Sweets
• If you are trying to lower the sugar in your diet, the an-
  swer is not to cut out all foods such as milk, fruits, and
  vegetables that naturally contain sugar. The body needs
  nutrients found in these foods. The better place to start
  cutting sugar from the diet is from foods that contain large
  amounts of added sugar, but are not sources of other
  nutrients.
• Ingredient labels provide information on sugar content. Sugar goes by a number of names, so look for the follow-
  ing terms on the ingredient list: sugar, sucrose, powdered
sugar, maple sugar, brown sugar, glucose, dextrose, corn syrup, fructose, levulose, high fructose corn syrup, honey, milk sugar, lactose, or maltose.

**Beverages**
- Substitute 1/2 fruit juice and 1/2 club soda for soft drinks, punches, and other drinks.
- Try unsweetened tea with a twist of lemon, lime, or a sprig of fresh mint.
- Try water, mineral water, or club soda with a slice of fresh lime or lemon.
- Reduce consumption of soft drinks containing sugar. Instead choose fruit juices, unsweetened iced tea, buttermilk, and low-fat milk.
- Try unsweetened coffee with a stick of cinnamon or an orange slice.

**Snacks**
- Substitute popcorn, raw vegetables, and fresh fruits for sweet snacks. Make these healthful foods easy to find and eat. Prepare them ahead of time and store in the refrigerator. Store in an airtight plastic container labeled "snack foods."
- Make your own dips, since commercially prepared ones often contain sugar. Then use raw vegetables as dippers in place of snack crackers, which often contain sugar.

**Condiments**
- Try making your own salad dressing. Many commercial dressings, both bottled and packaged mixes, contain a large amount of sugar.
- Try coriander, basil, nutmeg, cinnamon, and ginger for a light, sweet taste.
- Read labels on bottled sauces and packaged seasoning mixes. You can easily make a similar version at home without the added sugar.

**Sugar Alcohols**
Sugar alcohols provide calories, although they provide fewer calories than regular sugars because they are not completely absorbed. This allows products, which contain sugar alcohols to be labeled “sugar free,” or “reduced calorie.” Products may claim to be “sugar free” but this does not mean they are “calorie free.”

Sugar alcohols occur naturally in fruits and vegetables. The body absorbs sugar alcohols slowly and incompletely. As a result they enter the blood stream slower than natural sugars. Because of the incomplete absorption sugar alcohols produce a lower blood glucose response than sugars. However, side effects also occur because of the incomplete absorption. Large amounts can cause gas, abdominal discomfort, and diarrhea due to fermentation by intestinal bacteria (similar to lactose intolerance). For this reason, food products containing sugar alcohols carry a label “Excess consumption may have a laxative effect.”

The real benefit of using sugar alcohols is that they do not contribute to dental caries. Bacteria in the mouth can not metabolize sugar alcohols as rapidly as sugar.

**Non-Caloric Sweeteners**
Non-caloric sweeteners are used in many foods. Most non-caloric sweeteners do not provide significant calories; however, foods containing non-caloric sweeteners may not always be lower in calories than similar products that contain sugars.

The FDA has approved several non-caloric sweeteners: saccharin, aspartame, acesulfame K, sucralose, neotame and advantame. Stevia is an herbal sweetener. The FDA has given stevia the status of "generally recognized and safe" (GRAS).
- Saccharin. It is stable and does not break down in cooking, but has a bitter aftertaste when used in large amounts. The common brand name is Sweet and Low®.
- Aspartame. Aspartame contains the two amino acids, phenylalanine and aspartic acid. It has little aftertaste. Aspartame cannot be used in baking, because it breaks down with heat. Persons with PKU (phenylketonuria) should avoid its use. The common brand names are Nutra-Sweet® and Equal®.
- Acesulfame-K. Acesulfame K is stable and does not break down in cooking and has little aftertaste. The common brand name is Sunette® and SweetOne®.
- Sucralose. Sucralose is stable and does not break down in cooking. The common brand name is Splenda®.
- Neotame. Neotame is stable and does not break down in cooking. Although neotame contains phenylalanine, it is not released in digestion. As a result, products containing neotame do not have to carry a warning for people with PKU.
- Stevia. Stevia is an herbal sweetener.
- Advantame. Advantame is heat stable and does not breakdown in cooking.

**References**
The Oklahoma Cooperative Extension Service  
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
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- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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