



Carbohydrates in the Diet

Janice Hermann, PhD, RD/LD
Nutrition Education Specialist

The major function of carbohydrates is to provide energy. The body uses glucose to provide most of the energy for the human brain. About half of the energy used by muscles and other body tissues is provided from glucose and glycogen, a storage form of carbohydrate. People do not eat glucose and glycogen, they eat foods rich in carbohydrates. The body converts carbohydrates mostly into glucose for immediate energy and into glycogen or fat as stored energy. Because many foods are high in carbohydrates, many people mistakenly think they are "fattening." Actually, choosing a high-carbohydrate, high-fiber, and low-fat diet can help with weight management. Grain foods, vegetables, fruits, and legumes provide lots of carbohydrates and fiber with little fat.

What are Carbohydrates?

Carbohydrates are long chains of sugar molecules that are mainly used for energy. There are three basic types of carbohydrates:

- 1) Monosaccharides are single sugars including:
 - Fructose
 - Glucose
 - Galactose
- 2) Disaccharides (simple sugars) are two sugars linked together including:
 - Sucrose (table sugar), composed of glucose and fructose
 - Lactose (milk sugar), composed of glucose and galactose
 - Maltose (malt sugar), composed of glucose and glucose
- 3) Polysaccharides (complex carbohydrates) are many sugars linked together including:
 - Starch, composed of many glucose molecules
 - Glycogen (storage form of carbohydrate in the body), composed of many glucose molecules
 - Fiber (nonstarch polysaccharides), composed of many glucose molecules, which the human body cannot break down

Digestion and Absorption

The goal of digestion is to break down carbohydrates into small molecules the body can absorb. The human body contains the digestive enzymes to break down starch into disaccharides and disaccharides into monosaccharides. The final products of carbohydrate digestion are the monosaccharides.

Oklahoma Cooperative Extension Fact Sheets
are also available on our website at:
<http://osufacts.okstate.edu>

The monosaccharides are absorbed by the small intestine and released into the blood stream. The monosaccharides are carried by the blood to the liver, where fructose and galactose are converted into glucose. Glucose is the primary monosaccharide used by the body for energy.

Since the human body lacks the enzymes to break down fiber into single sugars for absorption, fibers reach the lower intestine intact. There are many different types of fiber. In general, fibers are divided into two basic types, soluble fibers and insoluble fibers. Both types of fiber have important roles in health and regulating the passage of food through the intestine.

Functions of Carbohydrates

The major function of carbohydrates is to provide energy for bodily functions. This energy is needed to carry on body processes such as breathing, maintaining body temperature, and contraction and relaxation of the heart and muscles. Energy is also needed for physical activities. The brain, nerve cells, and developing red blood cells can only use glucose for energy.

Each gram of carbohydrate in food provides four calories of energy. Glucose is the main carbohydrate that the body breaks down for energy. The major pathway by which glucose is broken down for energy requires oxygen, and the final products are carbon dioxide, water, and energy. In the muscles, if oxygen is in short supply, some glucose can be broken down for energy by a different pathway that does not require oxygen; however, the final products are lactic acid and energy. Lactic acid builds up in the muscles and causes cramping.

Metabolism

Dietary carbohydrates provide glucose that body cells can use for energy. Excess glucose beyond what the body needs for immediate energy is converted into glycogen, a storage form of carbohydrate, or converted into fat and stored in body fat cells.

Glucose provides energy for all body cells. The brain and nerve cells use only glucose for energy. If blood glucose levels fall too low, glycogen is broken down to provide glucose. The body can only store enough glycogen to provide about a half-day's supply of energy. Since glycogen stores are only

enough to provide energy for a short time, the body needs a frequent supply of carbohydrates.

Although many cells use fat for energy, the brain, nerve cells, and developing red blood cells can not. The body cannot convert fat into glucose to a significant degree. Thus, without glucose, the body is forced to break down its protein tissues to make glucose for energy, which can lead to muscle loss.

In addition, when the body uses fat for energy, fat fragments combine to form ketone bodies. Some body cells can use ketone bodies for energy, but if fat is broken down too rapidly, ketone bodies begin to accumulate in the blood. This can cause a serious condition called ketosis that can lead to coma and death. The body needs at least 50 to 100 grams of carbohydrates a day to spare body proteins and prevent ketosis.

Carbohydrates and Health

Foods rich in complex carbohydrates, including grain foods, vegetables, fruits, and legumes, provide valuable vitamins and minerals and little fat in addition to starch and dietary fiber. A diet rich in complex carbohydrates from these types of food offers many health benefits. A diet rich in complex carbohydrates can help with weight management and prevent heart disease, cancer, diabetes, and intestinal disorders. For these reasons, dietary recommendations encourage a diet rich in grain foods, vegetables, legumes, and fruits.

Sugar has been the focus of many health concerns. During digestion, all carbohydrates, except fiber, are broken down into simple sugars. Sugars and starches occur naturally in many foods that also supply other nutrients such as milk, fruits, vegetables, breads, cereals, and other grain foods. Added sugars are sugars added to foods in processing or preparation. The body cannot tell the difference between naturally occurring sugars and added sugars because they are chemically the same. Many foods containing added sugars provide calories, but may have few vitamins and minerals. In the U.S., the major source of added sugar is non-diet soft drinks. Sweets, candies, cakes, cookies, and bakery items are also major sources of added sugars. Consuming a lot of foods high in added sugar is a concern because these foods

may provide excess calories that contribute to weight gain or lower the intake of more nutritious foods.

Both starches and simple sugars may pose a risk for dental caries. Sugars and starches begin breaking down to simple sugars in the mouth. Bacteria in the mouth ferment sugars and produce an acid that can dissolve tooth enamel. Good dental hygiene after meals and snacks removes carbohydrates and sugars from the teeth that can lead to tooth decay.

Recommended Carbohydrate Intake

The Dietary Guidelines recommend 45% to 65%, or about half of daily calories, should come from carbohydrate foods.

Most carbohydrates should come from foods such as breads, cereals, grains, vegetables, fruits, and legumes. Dairy foods also provide carbohydrates as lactose. The Dietary Guidelines encourage people to choose a diet with plenty of fruits, vegetables, whole grains, and fat-free or low-fat dairy foods. A diet following the MyPyramid can easily supply the recommended amounts of carbohydrates and fiber. Recommended amounts from each MyPyramid food group each day for a reference 2,000-calorie diet are:

- 6 oz. of grains
- 2.5 cups of vegetables
- 2 cups of fruit
- 3 cups of milk
- 5.5 oz. of meat and beans
- 6 teaspoons of oil

References

- Whitney, E.N. & Rolfes, S.R. *Understanding Nutrition*, 10th ed. Thomson/Wadsworth Publishing Co., Belmont, CA., 2005.
- United States Department of Agriculture. *MyPyramid: Steps to a Healthier You*. Accessed at www.mypyramid.gov, 2005.
- United States Department of Agriculture. *2005 Dietary Guidelines for Americans*. Accessed at: www.health.gov/dietaryguidelines/dga2005.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. Revised 1105 GH