

Lesson 3: Nutritional Properties of Foods

Major Food Groups

A complete meal has five parts. Meats, breads and cereals (also called grains), fruits, vegetables, and dairy products are the five major food groups. Fats, oils, and sweets should be used sparingly.

Six Classes of Nutrients

The five food groups can be divided into six classes of nutrients. These essential nutrients consist of: carbohydrates, proteins, fats, vitamins, minerals, and water.

Figure 3.1 - Nutrient Classes

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| <ul style="list-style-type: none">• Carbohydrates• Protein• Fats• Vitamins• Minerals• Water |
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Carbohydrates are energy-rich compounds that supply the majority of the body's energy, or caloric needs. Carbohydrates consist of carbon, hydrogen, and oxygen atoms in a $C_1H_2O_1$ ratio. Sugars, starches, and plant fibers provide carbohydrates with glucose, a monosaccharide, being the simplest form of carbohydrate.

Protein supplies the body with molecules that contain nitrogen. Eight essential amino acids are the building blocks of protein and consist of: leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine, along with histidine for childhood growth.

Fats (also called lipids), are the most energy-rich compounds. They provide necessary fatty acids for normal metabolism. They are also needed for transporting fat-soluble vitamins.

Vitamins are organic molecules that are needed in small amounts but can make big differences in one's health. Vitamin D can be synthesized by a healthy body, while the remaining vitamins must be supplied in the diet. At times, Vitamin D may also need to be a part of the diet to meet necessary levels. Vitamins are broken into two groups: fat-soluble and water-soluble. Vitamins A, D, E, and K are fat-soluble, while vitamins C and B complex are water-soluble.

Minerals are inorganic molecules needed in small amounts. The major minerals include Calcium (Ca), Phosphorus (P), Magnesium (Mg), Cobalt (Co), Sodium (Na), Chloride (Cl), Potassium (K), and Sulfur (S). The trace minerals consist of Selenium (Se), Fluorine (F), Iodine (I), Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn), Chromium (Cr), and Molybdenum (Mo).

Water is also a necessary nutrient. A person may survive several days, possibly weeks without food. However, without water, you can live only a few days.

Nutritional Characteristics

Meats are a primary source of protein. They also contribute carbohydrates, fats, vitamins, and minerals.

Breads and cereals are a primary source of carbohydrates. They also contribute protein, fat, vitamins, and minerals.

Fruits are a primary source of vitamins and minerals.

Vegetables are a good source of minerals and vitamins. Carbohydrates and protein are also supplied by fruits and vegetables.

Dairy products are excellent sources for all nutrient categories.

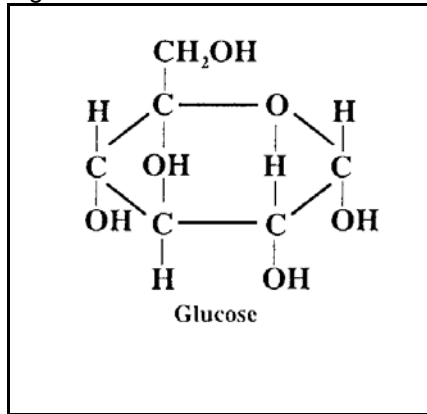
Fats and Sweets - Foods containing high amounts of fats and sweets tend to have very limited amounts of essential nutrients (vitamins, minerals, and protein). They are sometimes called empty calories.

Functions of Each Nutrient Class

Scientists use the terms "Kilo-calories" and "calories" in their discussions about nutrition. A Kilo-calorie (Kcal) is 1000 calories. One calorie (with the lowercase "c") is the amount of heat (i.e., energy) needed to raise the temperature of one gram of water one degree Celsius. Frequently, "Calories" with an uppercase "C" is used to indicate the number Kilo-calories in foods. Technically, these Calories are actually Kilo-calories. Throughout the discussion of nutrition in this manual, the number of Kilo-calories in a food will be identified as Calories.

Carbohydrates supply 4 Calories per gram of energy. Ninety-eight percent of sugars and starches are digested and fully oxidized into cellular energy. Carbohydrates are needed for body heat, tissue synthesis, and energy for work and play. Carbohydrates also supply carbon, which helps the body use fat efficiently, spare proteins from being converted to a major energy source, provide fiber, and promote vitamin B synthesis. Complex carbohydrates are long-chain molecules of glucose.

Figure 3.2 - Glucose Molecule



Proteins provide 4 Calories per gram of energy, but are only 70 percent digested and oxidized, on the average. Their primary roles are to supply nitrogen-based molecules necessary for tissue synthesis and to provide the essential amino acids needed for enzyme production. A complete protein contains all eight amino acids: leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, plus histidine for childhood growth.

Animal proteins are complete. Plant proteins are incomplete, meaning they are missing at least one of the essential amino acids. Most wheat, rice, and corn grains lack lysine. Legumes lack methionine. A lack of protein in early childhood can lead to retardation. A critical point is not how much protein is consumed, but rather a combination of the amount and the quality. Not all protein is digestible or palatable. A raw soybean is not digestible, but a processed soybean is digestible.

Fats provide 9 Calories per gram of energy. Approximately 95 percent of this is digested and oxidized. Fats provide essential fatty acids to the human diet. Linoleic acid is one essential fatty acid that promotes normal growth and prevents skin disorders. Research also suggests that linoleic acid, when present in high proportions compared to other dietary fats, may lower blood cholesterol. Dietary fat allows vitamins A, D, E, and K to be transported and absorbed. Fats contribute to phospholipid production and function. They help insulate and protect the body and store excess energy.

Vitamins serve a required function in enzyme systems which metabolize proteins, carbohydrates, and fats.

Vitamin A, or retinol, occurs only in foods from animal sources. Plants do contain beta-carotene, which is a precursor to vitamin A. Beta-carotene can be converted to vitamin A and is found in orange, yellow, and green leafy vegetables. A deficiency in vitamin A can lead to night blindness, abnormal bone and tooth development, or diseases of the epithelial cells.

Vitamin D can be formed in an animal's skin by ultraviolet sunlight activating cholesterol or ergosterol. Eggs, dairy products, liver, and fish oils are good food sources of vitamin D. This vitamin increases the absorption of calcium and phosphorus from the intestinal tract. A lack of vitamin D can lead to a bone defect condition.

Vitamin E favors iron absorption and serves as an antioxidant, which spares vitamin A and carotene from oxidation. Vegetable oils are good sources.

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Vitamin K is essential for normal blood clotting and is prevalent in cabbage and spinach.

Vitamin C, or ascorbic acid, prevents scurvy, bone joint diseases, teeth loosening, and fragile capillary walls. It is needed for normal protein collagen formation. It favors iron absorption. Good sources are citrus fruits, tomatoes, cabbage, and green peppers.

Nine specific B vitamins make up the B complex group. All are abundant in liver, yeast, and cereal grain bran. Thiamine, or B₁, is needed to oxidize glucose. Riboflavin, or B₂, is needed for cellular growth and tissue maintenance. Niacin is used for tissue respiration and oxidation of glucose. B₆ is needed for enzyme systems. Pantothenic acid is needed for mental health. B₁₂ helps prevent anemia and is required for nucleic acid formation. Folic acid also helps prevent anemia and is required for nucleic acid formation. Biotin helps metabolize fatty acids and amino acids.

Several minerals are necessary for growth and metabolism. Calcium (Ca) is needed for blood clotting, bone and tooth development, enzyme function, and to control fluid movement through membranes. Phosphorus (P) is required for normal metabolism, acid alkaline blood reactions, and phospholipid production. Milk and dairy products are excellent Ca and P sources. Magnesium (Mg) is required to help metabolize Ca and P for muscle contractions, electrical potential in nerves, and enzyme systems.

Iron (Fe) is needed for blood hemoglobin, the O₂ carrier, and muscle myoglobin, the O₂ storehouse. Iron is abundant and readily available in red meat. Copper (Cu) helps manufacture hemoglobin and aids in iron utilization.

Cobalt (Co) is a part of vitamin B₁₂. Zinc (Zn) is needed for enzyme production. Sodium (Na) is needed for osmotic equilibrium and body fluid volume regulation. Chlorine (Cl) exists as the chloride ion and is used to produce hydrochloric acid.

Potassium (K) is used to regulate osmotic pressure, equilibrium, and pH. Cellular enzymes need potassium.

Iodine (I) is needed for thyroid hormone production. Fluorine (F) prevents tooth decay. Manganese (Mn) is needed for bone structure, central nervous system function, and reproduction. Chromium (Cr) is used for glucose metabolism. Molybdenum (Mo) is required for protein metabolism.

Water is a vital nutrient although its functions are often overlooked. Besides comprising about 60 percent of a human's body weight, it serves as a chemical solvent for reactions in the body, it transports media to cells, removes body waste, regulates body temperature, and is essential for a controlled metabolic rate.

Nutrient Sources

To list every source of the six nutrients would require a listing of every food source known to man. Rather, an abbreviated list of foods that are particularly rich in a specific nutrient follows.

Carbohydrates come from potatoes, rice, flour, and dairy products.

Protein is found in meat, poultry, fish, eggs, legumes, and dairy products.

Fats are found in meat, poultry, grain oils, nuts, and dairy foods.

Vitamins come in fruits, vegetables, and dairy products.

Minerals are obtained from meat, fruits, vegetables, and dairy foods.

Water comes in beverages and high water-content foods.

Summary

Meats, breads and cereals, fruits, vegetables, and dairy products are the five main food groups. The body digests these foods into six major nutrient categories: carbohydrates, proteins, fats, vitamins, minerals, and water. Each nutrient serves an essential role in the body's health. These nutrients are found in a variety of food sources and are essential for a healthy diet.

Credits

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