

Paper No. 01

Paper Title: Food Chemistry

Module-01: Introduction to Major Constituents of Food

Food constituents are substances that provide nourishment essential for the maintenance of life and for growth. Food constituents are classified into the major groups which includes: carbohydrates, proteins, fats, vitamins, minerals, fiber & water.

1. Carbohydrates:

They are the chief source of energy in our diet. They are chemical compounds containing carbon, hydrogen and oxygen. They provide instant energy to our body. The chief sources of carbohydrates are: rice, wheat, maize, barley, potato, sugarcane, beetroot, banana, etc. The two kinds of carbohydrates are

1. Starch
2. Sugar

Starches are found in grains, legumes and tubers while sugar is found in fruits and plants. Carbohydrates are used by the cells in the form of glucose. After absorption from small intestine, glucose is processed in the liver, which stores some as glycogen, a starch like substance and passes the rest into bloodstream. Glucose forms triglycerides, which are fat compounds which can be broken down into ketones. Glucose is carried by the bloodstream to the muscle and organ to be oxidized and excess quantities are stored as fats to be retrieved at times of low carbohydrate intake. The carbohydrates containing the most nutrients are the complex carbohydrates such as unrefined grains, tubers, vegetables and fruits which also provide proteins, vitamins, minerals and fats. A less beneficial source is food made from refined sugar such as candy and soft drinks which are high in calories but low in nutrients.

2. Proteins:

Proteins are made up of amino acids. Proteins are formed by different combinations of twenty amino acids. Each amino acid contains carbon, nitrogen, hydrogen and oxygen. Some proteins contain elements like sulphur, phosphorus and iron as well.

Proteins can be classified into two groups depending on their source:

- i) Animal proteins are obtained from animal products like milk, cheese, egg, fish or meat.
- ii) Vegetable proteins are obtained from plants like pulses, soyabeans, nuts like cashew nuts, groundnuts, grains like barley, etc.

Animal proteins are considered to be better than vegetable proteins as they are more easily digested and absorbed by the body. Daily requirement of proteins for adults is about 1 gram per kg body weight. Children may require 2 to 3.5 grams per kg body weight because of their continuous growth.

Proteins also help to repair damaged body tissues. Proteins can also be utilized to provide energy during starvation. One gram of protein when burnt yields about 4 calories. The primary functions of proteins include building and repairing of body tissues, regulation of body processes and formation of enzymes and hormones such as insulin that regulate communication among organ and cells, and other complex substances that govern body processes. Animal and plant proteins are not used in the form they are ingested but are broken down by digestive enzymes called proteases into nitrogen containing amino acids. Proteases disrupt the peptide bonds by which the ingested amino acids are linked, so that they can be absorbed through the intestine into the blood and recombine into the

particular tissue needed. Proteins aid in the formation of antibodies that enable the body to fight infection. Proteins serve as a major energy supplier. There are distinctive kinds of proteins, each performing a unique function in the body. Proteins form a major part of human body, next to water. Enzymes are chemical substances that take part in several chemical reactions. Enzymes are chemically proteins. For example, salivary amylase is an enzyme produced by our salivary glands that breaks down starch into sugar.

The composition of proteins in the body is: muscle contains about 1/3 protein, bone about 1/5 part and skin consists of 1/10 portion. The rest part of proteins is in the other body tissues and fluids. Even blood contains loads of proteins. In fact the hemoglobin molecule is composed of but proteins. Our body requires proteins for the purpose of maintenance and healthy growth. The need for consuming proteins is especially more for infants, young children, pregnant women and recovering patients. There is a constant breakdown of proteins in the body and this explains the reason why we need to consume proteins on a regular daily basis. It becomes of prime importance to ensure the daily-recommended protein intake, so as to improve health. Sources of protein include meat, fish and eggs, as well as non-animal products, such as beans and nuts.

3. Fats:

Fats like carbohydrates are energy-giving foods but are greatly concentrated sources of energy. One gram of fat when burnt gives 9 calories of energy. Fats are made up of carbon, hydrogen and oxygen. However, compared to carbohydrates, fats contain lesser amount of oxygen, and hence produce larger amount of energy when oxidized.

Fats can be classified as animal fats and vegetable fats depending on their source. Butter, ghee, milk, fish, meat, etc., are sources of animal fat while nuts and vegetable oils like groundnut oil, sunflower oil, mustard oil and sesame oil are sources of vegetable fat.

They produce more than twice energy compared to carbohydrates. Fat is stored in the body for later use when carbohydrates are in short supply. Animals need stored fat to tide them over dry or cold seasons as do human during time of scarce food supply.

A major part of the food we eat is used to derive energy for day-to-day activities. A small part of the remaining food is converted into fat and stored in the body. Fats thus constitute an energy bank in the body which provides energy whenever the need arises. Fat is mainly stored under the skin and protects internal body organs from jerks and shocks. Fats help in the absorption of vitamins A, D, E and K as these vitamins are soluble in fats. Fats also make food tastier. Fats take a longer time for digestion, hence we do not feel hungry for a long time after eating fried food.

Fats are broken down into fatty acids that pass into the blood to form the triglycerides. The fatty acids that contain many hydrogen atoms are called saturated fatty acids and are derived mostly from animal sources. Unsaturated fatty acids are those having some of the hydrogen atoms missing. This group includes monounsaturated fatty acids, which have a single pair of hydrogen missing and polyunsaturated fatty acid, which have more than one pair missing. Polyunsaturated fats are found mostly in seed oils. Saturated fats in bloodstream have found to raise the level of cholesterol and polyunsaturated fat tends to lower it. Saturated fats at room temperature are solid while polyunsaturated fats are liquid.

4. Vitamins:

Vitamins are organic compounds which enhance the metabolism of proteins, carbohydrates and fats. Without vitamins the breakdown of food could not occur. Certain vitamins participate in the formation of blood cells, hormones, nervous system chemicals and genetic materials. They are classified into two groups i.e. fat-soluble and water soluble vitamins.

- **Fat-soluble Vitamins: Includes vitamin A, D, E and K.**

They are usually absorbed with food that contains fat, further broken down by bile and the emulsified molecules pass through the lymphatic and veins to be distributed through the arteries. Excess amount is stored in the fats, liver and kidneys. As they can be stored so they don't have to be consumed everyday.

Vitamin A: It is essential for the health of epithelial cells and for normal growth. Deficiency leads to skin changes and to night blindness or failure of dark adaptation due to the effects of deficiency on retina. It can be obtained in the diet foods of animal origin such as milk, eggs and liver. In developing countries it is obtained from carotene, which is present in the green and yellow fruits and vegetables.

Vitamin D: Acts as a hormone and regulates calcium and phosphorous absorption and metabolism. Some vitamin D is obtained from eggs, fish, liver, butter, margarine and milk while human gets most of it from the direct sunlight. Its deficiency causes rickets in children or osteomalacia in adults.

Vitamin E: Is essential for many vertebrate animals but its role in the human body has not been established. No clear evidence exist that it alleviates any specific disease. It is found in seed oils and wheat germ.

Vitamin K: It is necessary for the coagulation of blood. It assists in forming enzymes prothrombin which in turn is needed to produce fibrin for blood clots. Vitamin K is produced sufficiently in the intestine by bacteria and also provided by leafy green vegetables such as Spanich and egg yolk.

- **Water-soluble Vitamins: Includes vitamin C and B complex.**

Vitamin C: They cannot be stored and have to be consumed on daily basis to replenish body needs. Vitamin C is important in synthesis and maintenance of connective tissues, it prevents scurvy. Main source is citrus fruits.

Vitamin B complex: The important B-complex vitamins are thiamine (B1), riboflavin (B2), nicotinic acid or niacin, pyridoxine (B6), pantothenic acid, lecithin, choline, inositol, para-aminobenzoic acid (PABA), folic acid and cyanocobalamin (B12). These vitamins are used in a range of metabolic reactions in the body and prevent diseases such as beriberi and pellagra. They are found in yeast and liver.

5. Minerals:

Inorganic mineral constituents are required in the structural composition of hard and soft body tissues, they also participate in such processes as the action of enzyme system, the contraction of muscles, nerve reactions, and the clotting of blood. These mineral nutrients, all of which must be supplied in the diet are of classes, The major elements such as calcium, phosphorous, magnesium, iron, iodine, and potassium; and traces elements such as copper, cobalt, manganese, flourine and zinc.

Calcium is needed for muscle, heart and digestive system health, builds bone, supports synthesis and function of blood cells. Dietary sources of calcium include dairy products, canned fish with bones (salmon, sardines), green leafy vegetables, nuts and seeds.

Phosphorus is a component of bones and energy processing and many other functions. In biological

contexts. It combines with calcium in bones and teeth. Plays an important role in energy metabolism of the cell.

Magnesium is required for processing human metabolism and for maintaining the electrical potential in nerve and muscle cells. Deficiency can result in malnourished people, especially alcoholics, leads to tremors and convulsions.

Sodium is a systemic electrolyte and present in extra cellular fluid, which it plays a role in regulating. Too much use can cause edema. Now its evident that excess use of table salt Sodium-Chloride contributes to high blood pressure.

Iron is required for many proteins and enzymes, notably for the formation of hemoglobin. Sources include red meat, leafy green vegetables, fish (tuna, salmon), eggs, dried fruits, beans, whole grains, and enriched grains.

Iodine is needed to synthesize hormone of the thyroid gland. Deficiency cause goiter. Traces elements are other inorganic substances that appear in the body in minute amounts and are essential for good health. They include copper, which is required component of many redox enzymes. Its deficiency is associated with the failure to use iron in formation of hemoglobin. Zinc form enzymes, its deficiency causes impair growth in teeth and bones. Fluorides is important for protecting against demineralization of bone. Other trace elements include chromium, molybdenum, and selenium.

6. Fiber:

The cell walls of all plant cells are made up of cellulose. Cellulose cannot be digested by our digestive system. Although cellulose does not have any nutritive value for us, it is needed in our diet for proper functioning of the digestive system. Cellulose forms the fibre content of our diet and is referred to as roughage. Roughage provides the alimentary canal muscles with bulk against which they contract easily. This allows for more efficient movement of food in the alimentary canal, especially in the large intestine. Roughage helps in the regular movement of bowels. People who do not include roughage in their diet suffer from constipation. Salad, fruits, vegetables, whole cereals and whole legumes and pulses constitute the main sources of roughage in our diet.

7. Water:

Water forms about 70% of our body weight and is an important constituent of all body cells. Water is required for all the biological processes in our body. By weight water constitutes two third of the weight of a human body. It doesn't only maintain the temperature of body but removes waste products. In this way water is essential constituent of balanced diet. Although water does not provide energy, it is a very important nutrient. It performs the following functions in the body:

1. Water transports food, wastes, gases and other chemicals (like hormones) throughout the body.
2. Water helps in digestion by dissolving the nutrients which can then be absorbed or digested by the body.
3. Water carries waste out of the body as sweat and urine.
4. Water helps to regulate the body temperature.

The amount of water needed by a person depends on one's age, type or work and climate. Athletes and persons doing more of physical work must consume plenty of water as they lose a large amount of water as sweat. For the same reason more water is required by our body in summer than in winter.
