



Individual nutrient component:
Macronutrients: Proteins, lipids and
carbohydrates

by

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ILOs:

- Define the meaning of nutrition.
- Classify the nutrients
- Describe the macro-& micronutrients
- Mention the functions of macronutrients

References:

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- Thomas M. Devlin, Textbook of Biochemistry with Clinical Correlations, Jon Willey & sons, New York.
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Nutrition:

Nutrition is the science of food, the nutrients in foods and how the body uses those nutrients.

It includes the process of ingestion, digestion, absorption, metabolism, transport, storage and excretion of those nutrients.

It also includes the environmental, psychological and behavioral aspects of food and eating.

- Nutrition is the intake of food, considered in relation to the body's dietary needs (WHO).

Nutrients:

Nutrients: the chemicals in foods that are critical to human growth and function.

Classification:

- A. Macronutrients: required in large amounts;
 - 1. Carbohydrates
 - 2. Proteins
 - 3. Lipids
 - 4. Fiber (poor digested Carbohydrates)
 - 5. Water
- A. Micronutrients: required in small amounts;
 - 1. Minerals
 - 2. Vitamins

Macronutrients

Macronutrients are needed in larger quantities (in gram range). They normally include water, carbohydrates, fat and protein. Macronutrients (except water) are also called energy-providing nutrients. Energy is measured in calories and is essential for the body to grow, repair and develop new tissues, conduct nerve impulses and regulate life process.

Micronutrients

These nutrients include *minerals* and *vitamins*. Unlike macronutrients, these are required in very minute amounts. Together, they are extremely important for the normal functioning of the body. Their main function is to enable the many chemical reactions to occur in the body. Micronutrients do not function for the provision of energy.

Macronutrients

Carbohydrates – are required for energy and provide body's main source of energy (4 calories per gram); they form the major part of stored food in the body for later use of energy and exist in three form: sugar, starch and fiber. The brain works entirely on glucose alone. When in excess, it is stored in the liver as Glycogen. Carbohydrates are also important for fat oxidation and can also be converted into protein.

Fats – are used in making steroids and hormones and serve as solvents for hormones and fat soluble vitamins. Fats have the highest caloric content and provide the largest amount of energy when burnt. When measured by a calorimeter, fats provide about 9 calories per gram of fat, making them twice as energy-rich than protein and carbohydrates. Extra fat is stored in adipose tissue and is burnt when the body has run out of carbohydrates. Fats also provide essential fatty acids.

Proteins – they provide amino acids and make up most of the cell structure including the cell membrane. They are the last to be used of all macronutrients. In cases of extreme starvation, the muscles in the body, that are made up of proteins, are used to provide energy. This is called muscle wasting. As for carbohydrates, proteins also provide 4 calories per gram.

Water – makes up a large part of our body weight and is the main component of our body fluids. The body needs more water every day than any other nutrient and we replenish it through foods and liquids we eat and drink. Water serves as a carrier, distributing nutrients to cells and removing wastes through urine. It is also a compulsory agent in the regulation of body temperature and ionic balance of the blood. Water is completely essential for the body's metabolism and is also required for lubricant and shock absorber.

Micronutrients

Vitamins – are essential for normal metabolism, growth and development, and regulation of cell function. They work together with enzymes and other substances that are necessary for a healthy life. Vitamins are either *fat-soluble* or *water-soluble*. Fat soluble Vitamins can be stored in the fatty tissues in the body when in excess. Water soluble vitamins are excreted in urine when in excess and so need to be taken daily. Water soluble vitamins include Vitamin B and C. Green leafy vegetables are rich in Vitamin B, whereas Vitamin C is found abundantly in citrus fruits. Fat soluble vitamins are Vitamin A, D, E and K. Green leafy vegetables, milk and dairy products and plant oils provide these vitamins.

Minerals – are found in ionized form in the body. They are further classified into *macrominerals* and *microminerals* (or *trace minerals*). Macrominerals present in the body include Calcium, Potassium, Iron, Sodium and Magnesium to name a few. Iron is a constituent of Hemoglobin which is present in blood. Macrominerals are needed in more amounts, as compared to microminerals. Microminerals include Copper, Zinc, Cobalt, Chromium and Fluoride. They are mostly co-factors, and are necessary for the function of enzymes in the body, but are needed only in minor quantities. Approximately 4% of the body's mass consists of minerals.

Functions of macronutrients:

* **Functions of CHO:**

1. Source of blood glucose; the main and the primary fuel for body organs
2. Supply energy; 1 gram CHO gives 4 kcal
3. Source of non-essential amino acids (protein sparing effect)
4. Source of fructose in semen in males and galactose for lactose synthesis of milk in lactating females
5. Stored as glycogen in muscle and liver (source of energy in exercise and fasting)

Functions of macronutrients:

• Functions of fiber (Soluble & insoluble):

1. Dietary fiber helps reduce the chance of gastrointestinal problems such as **constipation** by increasing the weight and size of stool and softening it.
2. **Insoluble fiber**, found in whole wheat flour, and vegetables, especially stimulates **peristalsis**
3. Dietary fiber bind intestinal compounds (**phenolic** compounds and **bile**) helping their excretion with stool.
4. **Soluble fiber** in peas, beans, and many fruits, dissolves in water in the GIT to produce a gel that slows the movement of food through the intestines. This may help decrease the absorption of **glucose** and lowering its blood level.
5. Fiber, especially from whole grains, may help lessen **insulin** spikes, and reduce the risk of type 2 diabetes.
6. The link between increased fiber consumption and a decreased risk of **colorectal cancer** should also be considered.

Functions of macronutrients:

* Functions of proteins:

1. Proteins constitute tissue proteins (as contractile protein of muscle)
2. Synthesis of cell organelles as cell membrane, receptors, etc
3. Almost all enzymes are proteins (few exceptions do exist as ribozymes)
4. Some hormones that regulate metabolism are protein in nature (as insulin and GIT hormones)
5. Plasma proteins (albumin & globulins) maintain the plasma oncotic pressure and transport hormones, vitamins, minerals and drugs.
6. Synthesis of milk proteins in lactating women
7. Antibodies protecting against infection are proteins
8. Hemoglobin is a chromoprotein that carries oxygen in blood.
9. Blood coagulation factors are mostly proteins (N.B. factor IV is calcium)
10. Apolipoproteins solubilize lipids
11. Some physiologically active compounds are derived from proteins (creatine phosphate in muscles, purine and pyrimidines)
12. Synthesis of nucleoproteins
14. Energy but it is not the primary fuel

Functions of macronutrients:

*** Functions of Lipids:**

- 1. Lipids enter in the structure of cell membrane**
- 2. Lipids supply the body with energy (one gram gives 9.3 kcal)**
- 3. Lipids keep the body temperature as they act as insulator**
- 4. Lipids help fix the internal body organs in place (prevent organ ptosis)**
- 5. Lipids act as laxative in constipating patients**
- 6. Lipids in addition to muscles give the body contour**
- 7. Lipids make food palatable**
- 8. Lipids supply essential fatty acids and fat soluble vitamins associated with them**

Functions of macronutrients:

• **Functions of water (water is critical for survival):**

- 1. The human body is about 60 % water**
- 2. Cells need water to carry out their work**
- 3. Water keeps normal body temperature**
- 4. Water acts as lubricant in joints**
- 5. Protect sensitive tissues as spinal cord, etc**
- 6. Water is involved in many body processes: as fluid balance, nutrient transport, nerve impulse, muscle contraction, chemical reactions,etc**
- 7. Water get rid of wastes though urination, perspiration, bowel movement.**

Any questions?

