

BIOMOLECULES

The living matter is composed of mainly six elements — carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur. These elements together constitute about 90% of the dry weight of the human body. Several other functionally important elements are also found in the cells. These include Ca, K, Na, Cl, Mg, Fe, Cu, Co, I, Zn, F, Mo and Se.

Carbon—a unique element of life:

Carbon is the most predominant and versatile element of life. It possesses a unique property to form infinite number of compounds. This is attributed to the ability of carbon to form stable covalent bonds and C—C chains of unlimited length. It is estimated that about 90% of compounds found in living system invariably contain carbon.

Chemical Molecules of Life:

Life is composed of lifeless chemical molecules. A single cell of the bacterium, *Escherichia coli* contains about 6,000 different organic compounds. It is believed that man may contain about 100,000 different types of molecules although only a few of them have been characterized.

| <i>Biomolecule</i> | <i>Building block (repeating unit)</i> | <i>Major functions</i> |
|------------------------------------|--|---|
| Protein | Amino acids | Fundamental basis of structure and function of cell (static and dynamic functions). |
| Deoxyribonucleic acid (DNA) | Deoxyribonucleotides | Repository of hereditary information. |
| Ribonucleic acid (RNA) | Ribonucleotides | Essentially required for protein biosynthesis. |
| Polysaccharide (glycogen) | Monosaccharides (glucose) | Storage form of energy to meet short term demands. |
| Lipids | Fatty acids, glycerol | Storage form of energy to meet long term demands; structural components of membranes. |

Complex biomolecules:

The organic compounds such as amino acids, nucleotides and monosaccharides serve as the monomeric units or building blocks of complex biomolecules — proteins, nucleic acids (DNA and RNA) and polysaccharides, respectively. The important biomolecules (macromolecules) with their respective building blocks and major functions are given in Table 65.1. As regards lipids, it may be noted that they are not biopolymers in a strict sense, but majority of them contain fatty acids.

Structural hierarchy of an organism:

The macromolecules (proteins, lipids, nucleic acids and polysaccharides) form supra-molecular assemblies (e.g. membranes) which in turn organize into organelles, cells, tissues, organs and finally the whole organism.

Chemical composition of man:

The chemical composition of a normal man, weighing 65 kg, is given in Table 65.2. Water is the solvent of life and contributes to more than 60% of the weight. This is followed by protein (mostly in muscle) and lipid (mostly in adipose tissue). The carbohydrate content is rather low which is in the form of glycogen.

| <i>Constituent</i> | <i>Percent (%)</i> | <i>Weight (kg)</i> |
|--------------------|--------------------|--------------------|
| Water | 61.6 | 40 |
| Protein | 17.0 | 11 |
| Lipid | 13.8 | 9 |
| Carbohydrate | 1.5 | 1 |
| Minerals | 6.1 | 4 |

The basic information on the various biomolecules is essential for a better understanding of the concepts of biotechnology. The biomolecules namely nucleic acids (DNA and RNA) which are directly relevant to biotechnology are described.