Chapter-9

"Biomolecule"

- Biomolecules :→ Carbon containing chemicals and molecules that are involved in metabolic processes of living organisms are called Biomolecule or Biological molecules.
- Are all living organisms made of same chemicals, i.e. element and compounds ??
- On elemental analysis of plant tissue, animal tissue or microbial paste, we obtain a list of elements like C, H, O and many other Elements
- But when we perform same chemical / elemental analysis of on a piece of earth's crust (non-living matter) we obtain similar list.

** All elements present in earth's crust are also present in the sample of living tissue. [Qualitatively]

** On deep analysis or closer examination, scientists reveals that the relative abundance of C, H and O is higher in any living organism than in earth's crust.

=> "The elemental composition of living tissues and non-living matter appear to be similar when analysed qualitatively"

TABLE 9.1 A Comparison of Elements Present in Non-living and Living Matter*

Element	% Weight of Earth's crust	% Weight of Human body
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	negligible

* Adapted from CNR Rao, Understanding Chemistry, Universities Press, Hyderabad.

Q.1 How to analyse chemical composition :→

- we can find out chemical composition of living organism by performing chemical analysis.
- Take living tissue (like a vegetable or a piece of liver) + Grind it with Cl_3COOH (Trichloroacetic acid) using mortar and pestle
  → we obtain thick slurry
  → If we were to strain through a cheesecloth or cotton we obtain two fractions

Filtrate or acid soluble pool
- contain thousands of organic compounds
- It also contain inorganic compounds and elements
- they have molecular wt ranging from 18–800 daltons (Da)
- It roughly represent cytoplasmic composition

Retentate or acid insoluble fraction
It has four type of organic compounds
1. Proteins
2. Nucleic acids
3. Polysaccharides
4. Lipids

mol. wt ≥ 10,000 daltons (Da)

These compounds are separated from each other by various technique. Finally we isolate & purify compound.
Analytical techniques are applied to find out molecular formula & probable structure of compound.

* Inorganic compounds or elements are best detected by destructive experiment.

Take a small amount of living tissue & weigh it
→ the weight obtained is "wet weight"
↓
Dry it by process of heating → Are H2O evaporates
↓
we obtain dry weight
↓
Fully burn it (combustion) — Carbon compounds converted to CO_2 & H_2O ?
↓
remaining part is called "Ash"

Ash contains inorganic elements like Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}

∴ Elemental analysis gives elemental composition of living tissue in the form of H, C, O, Cl, C etc. while analysis for compounds gives an idea of the kind of organic and in-organic constituents present in living tissue.

Biomolecules

Bio micromolecule	Biomacromolecule
mol wt < 1000 Da	(found in acid insoluble fraction)

** Lipids are not polymer ⟹ mol. wt < 800 Da they are of smaller molecular wt ∴ they are not macromolecule.

*** When we grind tissue, we are disrupting the cell structure. Cell membrane and other membranes are broken into pieces, & form vesicles which are insoluble in water.
∴ These membrane fragments in form of vesicles get separated along with the acid insoluble pool and hence in macromolecular fraction.

Chemical composition of living tissue (average)

Component	% of the total cellular mass
Water	70–90 %
Proteins	10–15 %
Carbohydrates	3 %
Lipids	2 %
Nucleic acids	5–7 %
Ions	1 %

** Water is most abundant chemical in living organisms.