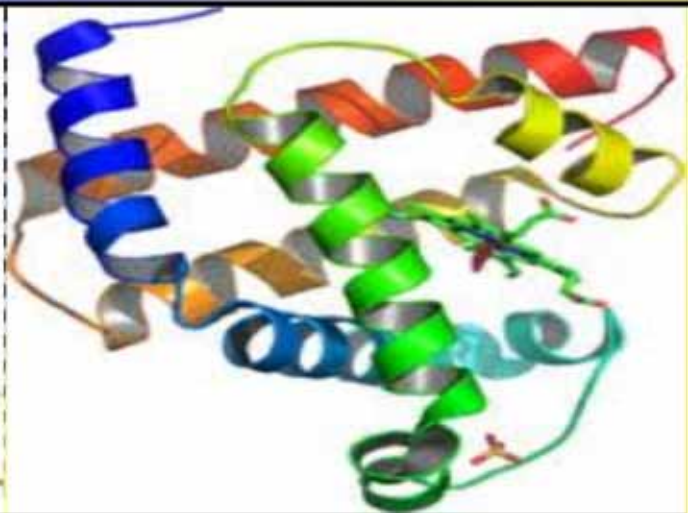
Chemistry of Protiens and Lipids



Learning Outcomes:

Students will be able to:

1. describe the bonding in a protein molecule;
2. observe and explain the denaturing of proteins;
3. differentiate between fats and oils;
4. explain hydrogenation of vegetable oil.

Proteins

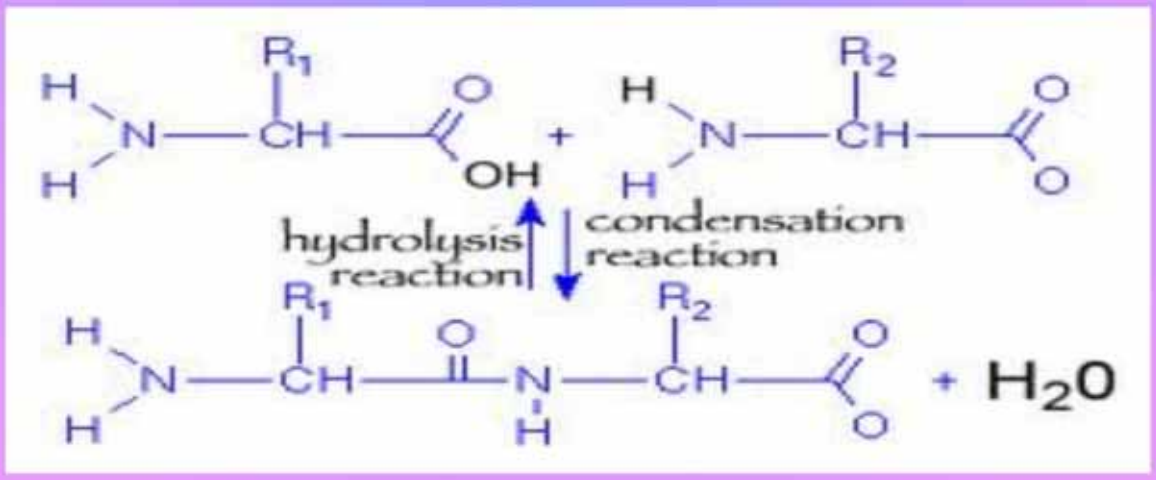
The most important of the known components of the living matter is a protein and without this life would not be possible. All proteins are chemically similar, but they perform many different functions in living things. They act as structural materials (e.g skin and finger nails). They make the muscle fibres that enable animals to move. They are the basic material of enzymes which catalyse many chemical reactions that are the driving force of all organisms.

Proteins are long chain molecules made by linking together relatively small molecules called amino acids. There are 22 different amino acids found widely in nature and proteins contain a variable number of amino acid units.

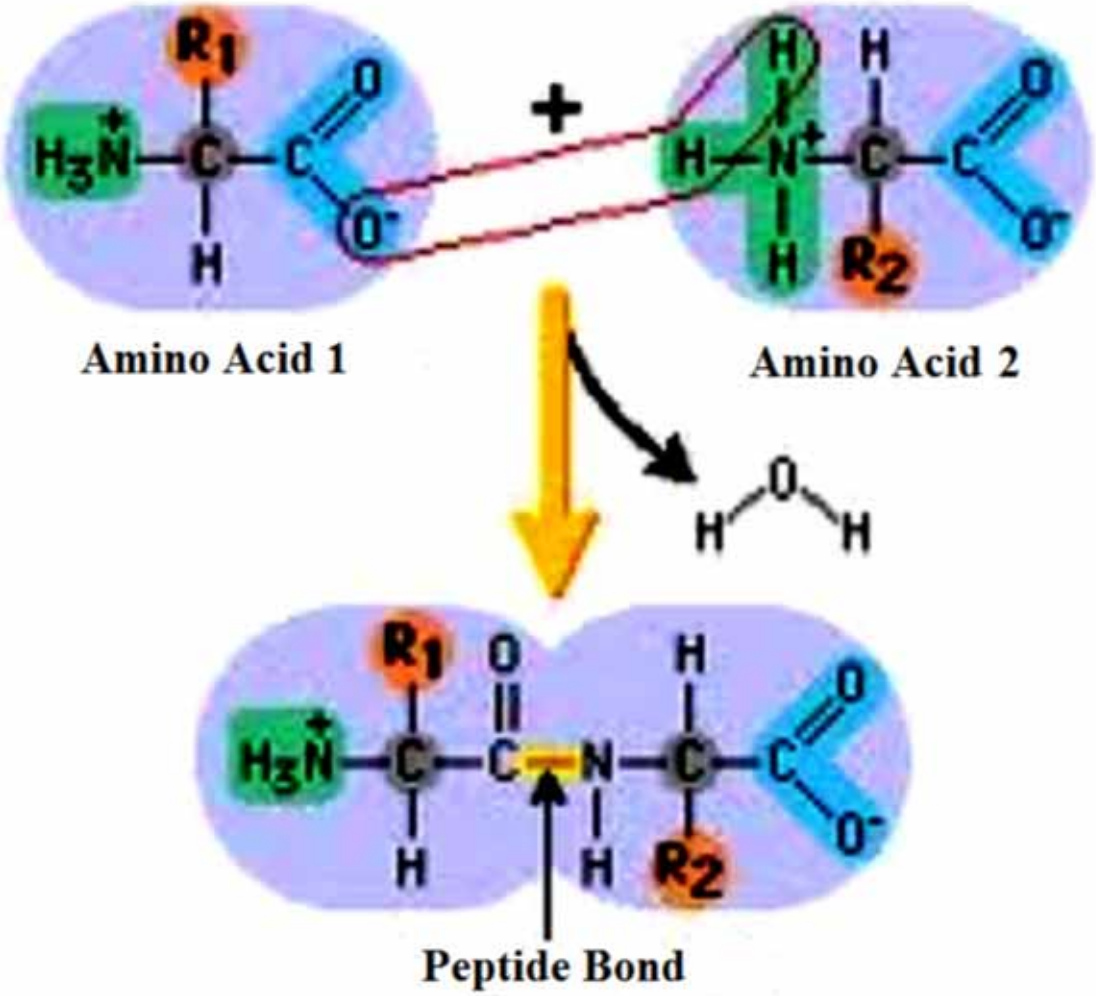
Proteins have high molar masses, ranging from about 5000 gm to $1x10^7$ gm. The mass composition of proteins by elements is remarkably constant; carbon 50-55%, hydrogen 7%, oxygen 23%, nitrogen 16% and sulphur 1%.

Bonding in a Protein Molecule:

The first step in the synthesis of a protein molecule is the condensation reaction between two amino acids.



The resulting carbon-nitrogen bond is called a ***peptide bond***. The molecule formed from two amino acids is called a ***dipeptide***. Either end of the dipeptide can engage in a condensation reaction with another amino acid to form a ***tripeptide***, and so on.


Amino Acid 1
Amino Acid 2
Peptide Bond

The final product i.e. the protein molecule, is a *polypeptide*; it can also be thought of as a *polymer of amino acids*.

Denaturing of Proteins:

When proteins are subjected to unusual drastic physical or chemical changes, they lose some or all of their three dimensional structure. Proteins in this stage no longer exibit normal biological activities and are said to be denatured proteins.

Animation

Lipids

Differences between Fats and Oils:

"Fats and oils are esters of long chain fatty acids with glycerol."

They are also called *triglycerides*. Common examples of triglycerides are butter, animal fat, sunflower oil, corn oil and cotton seed oil.

Fats are solid at room temperature while oils are liquids. But, both of these are esters of glycerol. However, in oils there is a large percentage of unsaturated carboxylic acid chains, while fats contain saturated carboxylic acid chains. Thus, in the case of oleic acid molecule there is a double bond between the 9^{th} and 10^{th} carbon atoms and

and its structure is given below:

$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$

Oleic acid

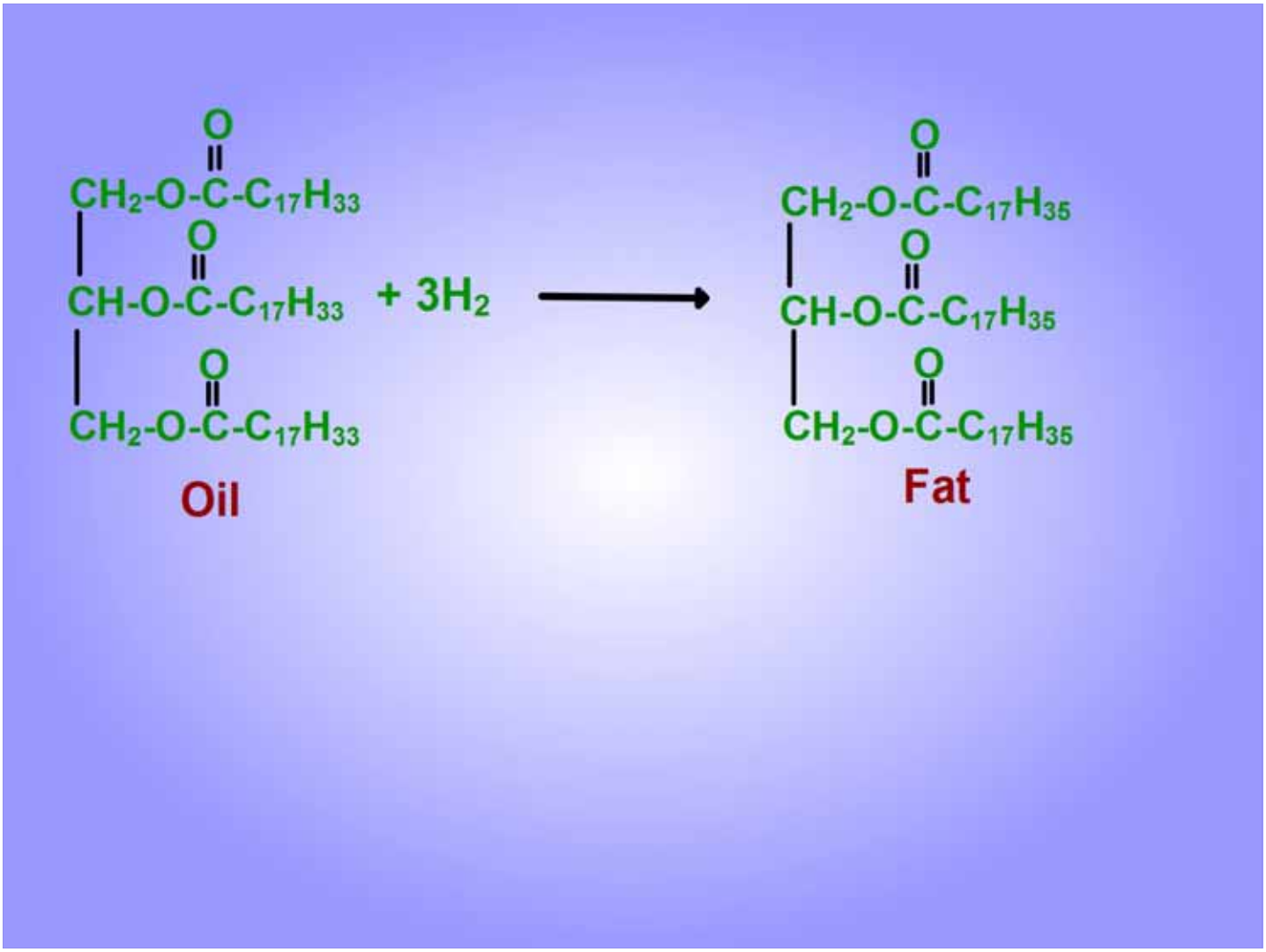
Other common acids which form glycerides are palmitic and stearic acids.

Palmitic Acid: $C_{15}H_{31}COOH$

Stearic Acid : $C_{17}H_{35}COOH$

Hydrogenation of Vegetable Oils:

"Hydrogenation is the process by which oils are converted into fats". **In hydrogenation, hydrogen gas is bubbled through oil at about 180°C, under pressure, in the presence of finely divided nickel catalyst. Hydrogen adds at the double bond resulting in a larger proportion of the saturated glycerides. This raises the melting point and the oil changes into fat, like margarine. The process is also called the *'Hardening of Oils'*.**


CH2-O-C-C17H33
O
CH-O-C-C17H33
O
CH2-O-C-C17H33
O
+ 3H2
CH2-O-C-C17H35
O
CH-O-C-C17H35
O
CH2-O-C-C17H35
O
Oil
Fat


Multiple
Choice
Questions

1. Which of the following biological molecules acts as enzymes?

A. Cellulose
B. Proteins
C. Fatty acids
D. Starch

2. Amino acids exist in a dipolar structure, which is commonly called as

A. cation.
B. anion.
C. carbocation.
D. zwitterion.

3. Proteins are supposed to be the polymers of amino acids. The linkages that occur between amino acids in protein molecules are known as

A. etherial bond.
B. glycosidic bond.
C. hydrogen bond.
D. peptide bond.