

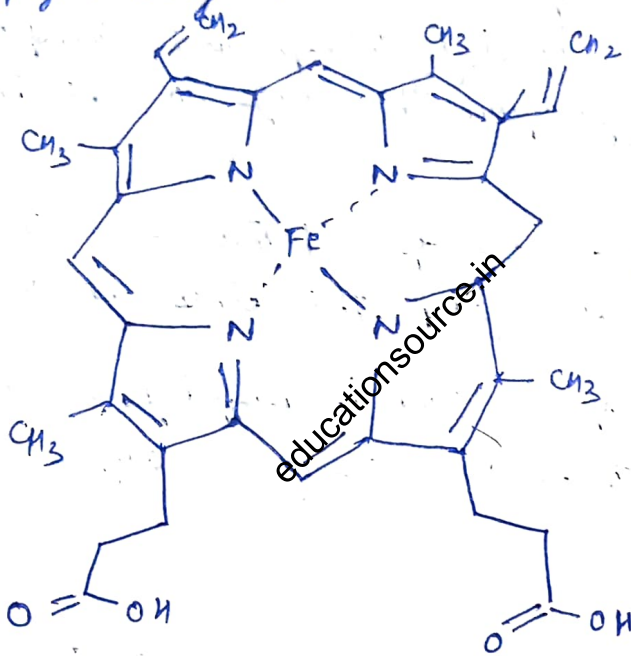
Heme and Non-Heme Proteins and Enzymes :-

Unit - II

Heme and Non-heme Proteins

Heme and Non-heme proteins are two types of proteins that differ in their structure and function.

Heme Proteins are a type of protein that contains a heme group, which is a complex molecule made up of a Porphyrin ring and an iron ion in the center.



- ① The heme group is responsible for binding and transporting oxygen and other molecules in the body.
- ② Examples of heme proteins include hemoglobin and myoglobin, which are both involved in the transport and storage of oxygen in the body.

Non-heme Protein:-

- ① They do not contain a heme group. These proteins can have variety of functions, including enzymes catalysis, and transport of small molecules.
- ② Examples of Non-heme proteins include insulin, which regulates blood sugar levels and lysozyme, which breaks down bacterial cell walls.

Hemoglobin and myoglobin.

Hemoglobin and myoglobin are two heme proteins that are involved in the transport and storage of oxygen in the body.

Hemoglobin :-

- ① It is a protein found in red blood cells that is responsible for binding ~~transp.~~ and ~~transportation~~ and transporting oxygen from the lungs to the body's tissues.
- ② Hemoglobin is composed of four protein subunits, each containing a heme group that binds to oxygen.
- ③ Hemoglobin also plays a role in buffering the blood's pH by binding to and releasing hydrogen ions.

Myoglobin :-

- ① It is a protein found in muscle tissue that is responsible for storing oxygen for use during muscle contractions.
- ② Myoglobin has a similar structure to hemoglobin with a single protein subunit containing a heme group.
- ③ Myoglobin has a higher affinity for oxygen than hemoglobin which allows it to efficiently store oxygen in muscle tissue.

oxygen transport and storage

oxygen transport and storage are essential functions in the human body.

transport of oxygen

- ① oxygen is transported in the blood by hemoglobin, a protein found in red blood cells.
- ② Hemoglobin binds to oxygen in the lungs and carries it to the body's tissues.
- ③ oxygen in the tissue provides energy by cellular respiration.
- ④ Hemoglobin's ability to bind to oxygen due to heme group.

Storage of oxygen

- ① oxygen can be stored in various tissues in the body particularly in muscle tissue.
- ② The oxygen is stored in muscle by myoglobin.
- ③ Myoglobin has a higher affinity for oxygen than hemoglobin.

Electron transfer and oxygen Activation :-

Electron transfer and oxygen activation are two processes that are interconnected, particularly in biological systems.

Electron transfer :-

- ① It is the movement of electrons from one molecule to another.
- ② In biological systems this process is done by electron carrier molecules, such as NADH or FADH₂.

③ Which transport electrons during metabolic reactions.

Oxygen Activation :-

- ① It is a process by which oxygen is converted into reactive oxygen species such as superoxide or hydrogen peroxide.
- ② Oxygen activation is done by enzymes called oxidases.
- ③ Which ~~transp~~ transfer electrons to oxygen to produce reactive oxygen species.

Cytochromes, ferredoxins and Rubredoxin :-

Cytochromes, ferredoxins and Rubredoxin are three types of electron carrier proteins that play important roles in electron transfer processes in biological systems.

Cytochromes :-

- ① They are heme-containing proteins that transfer electrons through a series of redox reactions.
- ② They are found in many different organisms and are involved in a variety of processes such as photosynthesis and respiration.
- ③ Cytochromes can be classified into different groups based on their heme structure.

Ferredoxins :-

- ① They are iron-sulfur proteins that transfer electrons in a variety of metabolic pathways such as photosynthesis and respiration.
- ② They contain clusters of iron and sulfur atoms that act as electron transfer centers.
- ③ Ferredoxins are typically smaller than cytochromes and have a more rigid structure.

Rubredoxins :-

- ① They are small, non-heme iron proteins that also transfer electrons that also transfer electrons in metabolic pathways.
- ② They contain a single iron atom that can exist in either an oxidized or reduced state allowing it to participate in electron transfer reactions.
- ③ They are found in a variety of organisms, including bacteria and archaea.

Model systems, mononuclear non-heme enzymes.

Model systems :-

- ① They are simplified versions of biological systems that are used to study specific aspects of biological processes.
- ② They are simpler than the actual biological system, but they can provide insight into the mechanisms that are involved in biological processes.

Mononuclear non-heme iron enzymes.

- ① They are a class of enzymes that contain a single iron atom in their active site and are involved in a variety of biological processes, such as oxygen transport, DNA synthesis and antibiotic biosynthesis.
- ② They are studied using model systems to gain a better understanding of their structure and function.

Example of a model system for studying mononuclear non-heme iron enzymes is the synthetic complex.

$\text{Fe(II)(bpy)(N}_3)_2$ and Protein Rubredoxin.

Copper - Containing Proteins :-

⇒ Copper containing proteins are a class of
⇒ Copper containing proteins can be classified into
several categories based on their function and structure.
Here are some examples of copper containing proteins
and their roles in electron transfer, oxygen transport,
oxygenation, oxidases and reductases and nickel - containing
enzymes.

Electron transfer :-

Azurin: A small blue copper-containing protein involved
in electron transfer in bacteria and archaea.

Plastocyanin: a copper-containing protein found in plants
and algae that is involved in electron transfer
during photosynthesis.

oxygen transport :-

Hemocyanin: a copper-containing protein found in some
mollusks and arthropods that transports oxygen.

Hemerythrin: A non-heme iron protein that also
transports oxygen, but contains copper ions as
cofactors.

oxygenation :-

Dopamine β -monooxygenase: A copper-containing
enzyme that is involved in the conversion of
dopamine to norepinephrine.

Laccase: A copper-containing enzyme that is involved
in the oxidation of phenolic compounds.

Oxidases and Reductases:

Cytochrome c oxidase: a copper-containing enzyme found in the mitochondria that is involved in the final step of aerobic respiration.

Copper - Zinc Superoxide dismutase :-

a copper containing enzyme that plays a role in protecting cells from oxidative stress.

[Nickel-containing enzyme: urease]

- ① urease is a nickel containing enzyme that catalyzes the hydrolysis of urea into ammonia and carbon-dioxide.
- ② urease is found in many bacteria, fungi and plants as well as in some marine invertebrates.
- ③ Urease is essential for the survival of many microorganisms, as it allows them to utilize urea as a source of nitrogen.
- ④ urease is an important enzyme that plays a critical role in the nitrogen cycle and has many practical applications in various fields.