Chapter 11

Biological Electron Transfer Complex

Biological electron transport proteins are mainly

(1) Iron-sulfur proteins. For example: Ferrodoxins, Rubredoxin

(2) Heme protein such as cytochromes.

11.1. Iron-Sulfur Proteins:

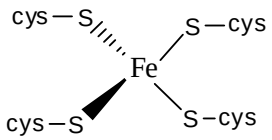
Iron-sulfur proteins function as electron carrier in biological redox reaction such as photosynthesis, nitrogen fixation and mitochodrial respiration. These consist of non heme iron, cordinated by cysteine sulphur and acid labile inorganic sulphide sulfur (S^{2-}). They are found in bacteria, algae, fungi, higher plants and mammals.

$RS_4Fe_4S_4 + 8H^+ \longrightarrow (RS)_4\ Fe_4 + 4H_2S$ (where, R = Cys)

Classification of iron sulfur proteins:

S. No.	Fe – S	Name	No. of electrons involved in electron transfer reaction
1.	1 – 0	Rubredoxin	1
2.	2 – 2	2-Iron ferredoxin	1
3.	3 – 4	3-Iron ferredoxin	1
4.	4 – 4	4-Iron ferredoxin	1

(1) Rubredoxin:

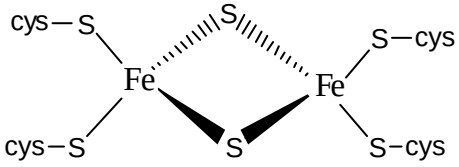


Active site structure of Ruberdoxin

- It is represented as Fe–S proteins.
- It contain one ion and no acid labile S^{2-}.
- Geometry is distorted tetrahedral.
- It is low molecular weight protein (Mw = 6000 daltons) consisting of 53-54 amino acids.
- It is a one electron transfer agent, with both Fe^{+2} and Fe^{+3} having high spin configuration.

$$\underset{Fe(II)}{[Fe(RS)_4]^{2-}} \rightleftharpoons \underset{Fe(III)}{[Fe(RS)_4]^{-}}$$

(2) (a) Ferredoxins (Fe_2S_2):

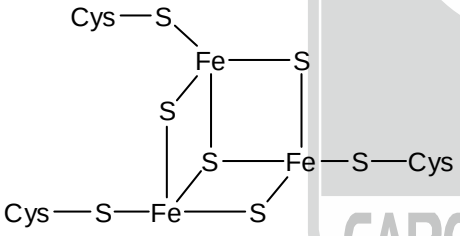


Active site structure of Fe_2S_2 proteins.

- It occur in the chloroplast of many plants, in serveral bacteria, beef heart mitochondria and pig adrenal glands.
- Its active site contains two Fe centres bridge by two acid lable (S^{2-}) sulphur and each Fe is bound to two systein sulfur atoms of the protein chain in such as a manner that the individual (Cys-S), Fe(S^{2-}) unit appear tetrahedral providing high spin configuration to Fe.
- The oxidised form of ferrodoxin is diamagnetic in nature and esr inactive.
- Reduce form of ferrodoxin is paramagnetic and of esr active.
- Fe_2S_2 function as one electron transport proteins.
- Iron centres in the reduced form are non-equivalent, though they are equivalent in the oxidised form.
- It is also called photosynthetic ferrodoxin.

$$\underset{2[Fe(II)]}{[Fe_2S_2(RS)_4]^{4-}} \rightleftharpoons \underset{Fe(II)+Fe(III)}{[Fe_2S_2(RS)_4]^{3-}} \rightleftharpoons \underset{2[Fe(III)]}{[Fe_2S_2(RS)_4]^{2-}}$$

(b) Ferredoxin (Fe_3S_4):



- It is called 3-Iron ferrodoxin
- Active sites of these protein consist of three iron atoms, four acid labile sulphide sulphur (S^{2-}) and three cysteinyl sulphur atom.
- In oxidized form all the three Fe atoms are as Fe^{+3} and in reduced state it is containing $2Fe^{+3}$ and $1Fe^{+2}$.

$$[(RS)_3Fe_3S_4]^{2-} \rightleftharpoons [(RS)_3Fe_3S_4]^{3-}$$

(c) Ferredoxin (Fe_4S_4):