

VIVEKANANDA COLLEGE
THAKURPUKUR
KOLKATA-700063

NAAC ACCREDITED 'A' GRADE

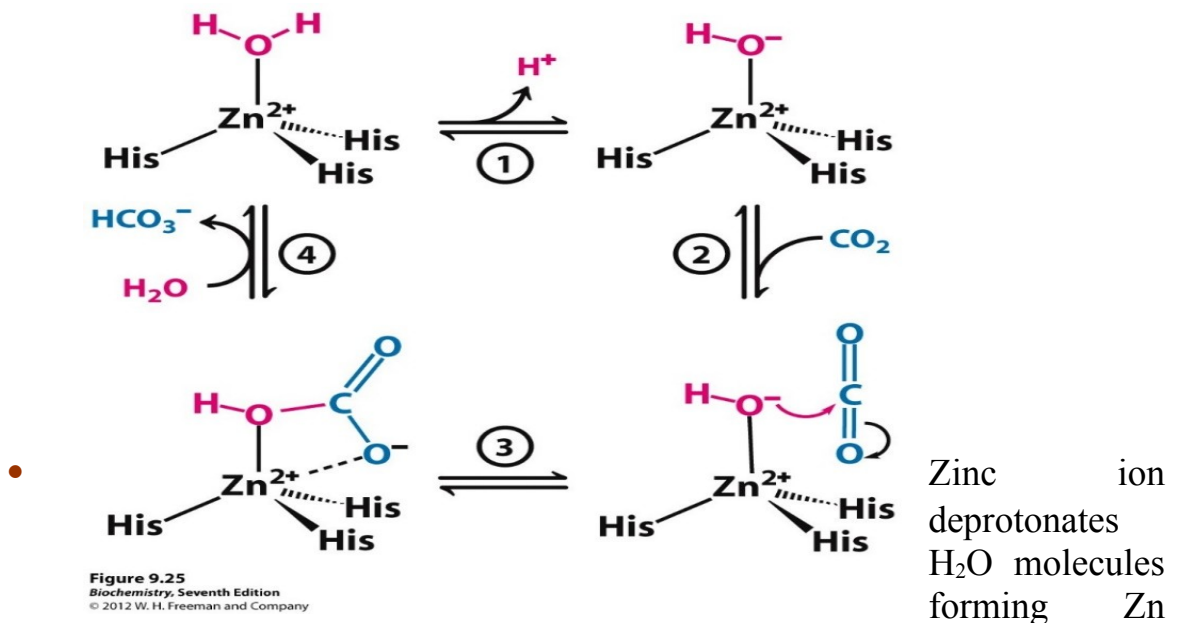


Topic : Enzyme Kinetics
Course Title : Enzymes
Paper : CC4
Unit : II
Semester : 2
Name of the Teacher : Dr. Kakali Roy
Name of the Department : Biochemistry

Metal ions on the activity of enzyme

❖ Zn^{+2}

- Metal ion zinc acts as a cofactor for many enzymatic reactions and bind to apoenzyme like carbonic anhydrase.
- Carbonic anhydrase has important role in respiration by influencing CO_2 transport, containing Zn^{+2} at its active site.
- Zinc is attached to imidazole ring of 3 Histidine residues and one water molecule forming a distorted tetrahedron at the active site.



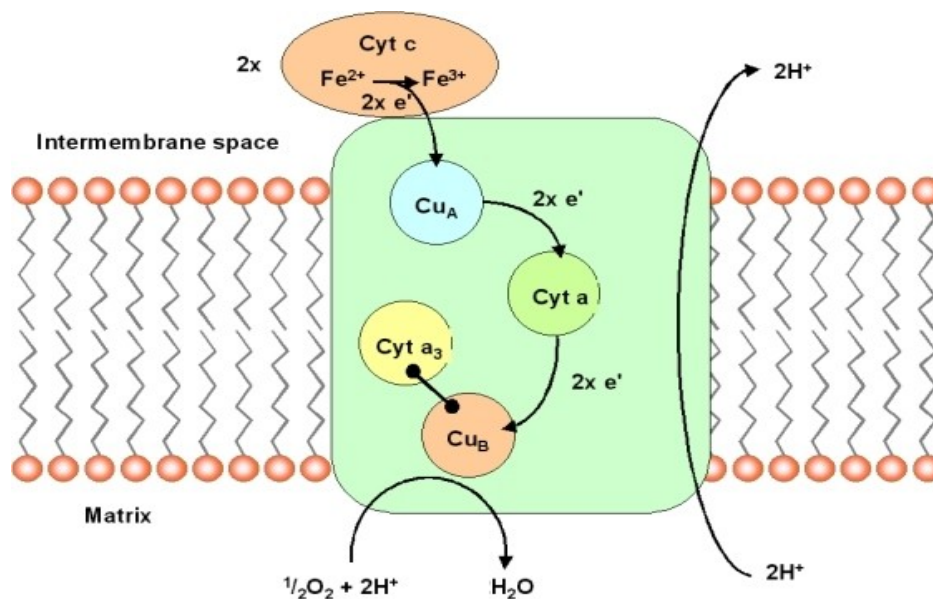
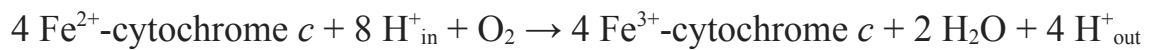
bound hydroxide ion

- Zn bound OH^- ion acts as a potent nucleophile and attacks CO_2 for hydration

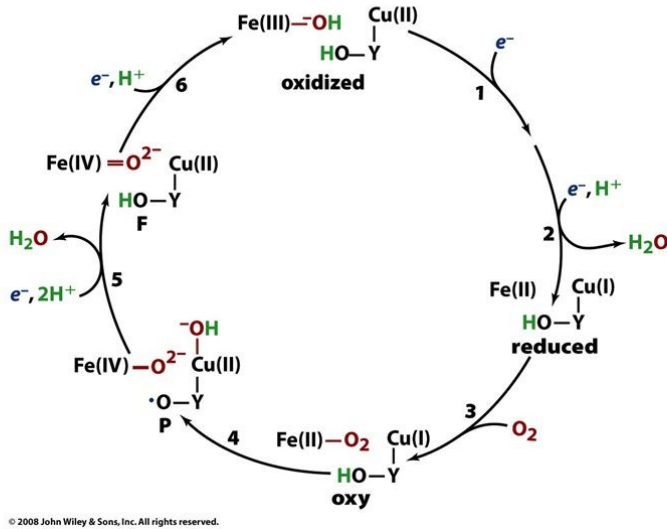
- CO_2 binds to hydroxide ion moiety of Zn ion and forms Zn bound bicarbonate ion
- Bicarbonate ion is released and the enzyme is regenerated for binding another H_2O molecule.

➤ Cu^{+2}

- Copper containing enzyme is Cytochrome oxidase
- Cytochrome oxidase the terminal enzyme of the Electron Transport Chain possesses copper at its active site.
- Cytochrome C oxidase catalyzes the one electron oxidation of four consecutive reduced cytochrome c molecules
- The concomitant four electron reduction of one O_2 molecule to yield H_2O .



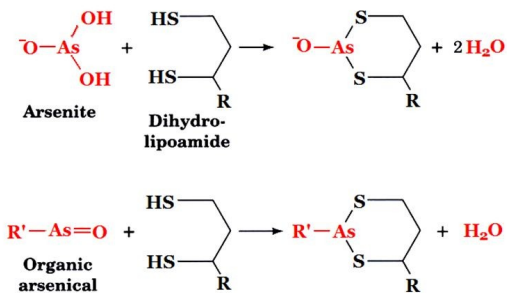
Proposed Reaction Sequence for Cytochrome c Oxidase



❖ As^{+3}

- As^{+3} exerts its toxic action by attacking $-\text{SH}$ groups of an enzyme thereby inhibiting enzyme action.

Arsenic Compounds Are Poisonous in part because They Sequester Lipoamide



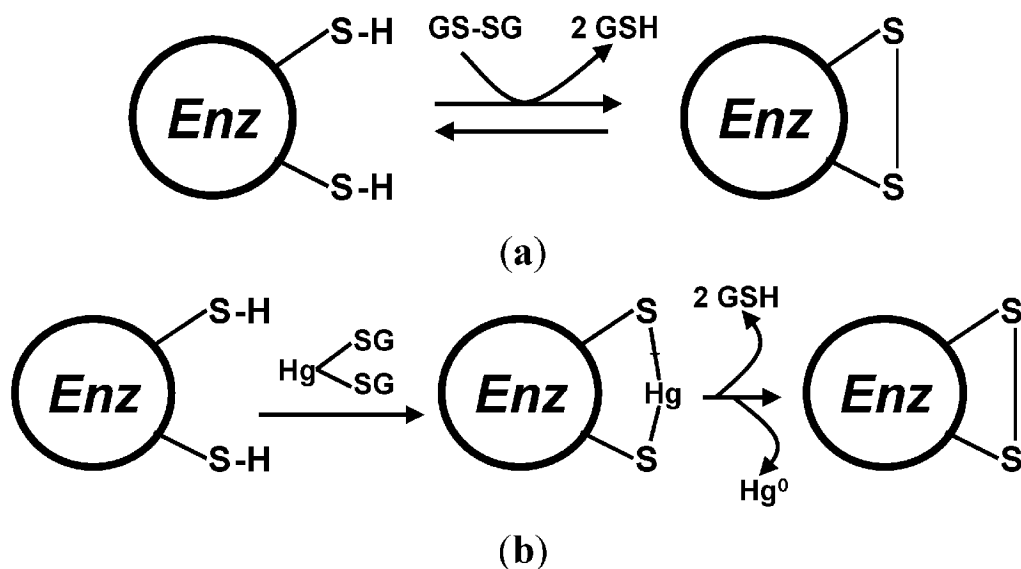
arsenic compounds ----- respiration to a halt.

- Arsenite [As(III)] and organic arsenicals are toxic ----- ability to bind covalently to sulfhydryl ($-\text{SH}$) compounds.
- Lipoamide containing Citric acid cycle enzymes, Pyruvate dehydrogenase and α -ketoglutarate dehydrogenase are inactivated by these two

- As^{+3} interferes some biochemical processes involving phosphorous due to its chemical similarity
- It interferes the glycolytic step Glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate to prevent ATP generation.
- Phosphorylation replaced by arsenolysis.

❖ Hg^{+2}

- High affinity for sulphur atoms Hg^{+2} easily attaches itself to sulphur containing amino acid of protein enzymes, like Glutathione reductase.
- Non competitively inhibits the enzyme active site.
- $E-SH + Hg^{+2} \rightarrow E-S-Hg + H^+$



Reference :

1. Biochemistry, seventh Edition, J.M. Berg; J.L. Tymoczko; L. Stryer, W.H.Freeman and Company (New York), 2012.
2. Biochemistry 3rd Edition, Voet and Voet, John Wiley & Sons, INC.
3. <https://doi.org/10.3390/toxics3010020>