M.SC Semester III
Core Course XI
Bio-Inorganic Chemistry

TOPIC:-Unit III, Myoglobin

Department of Chemistry
L.S COLLEGE MUZAFFARPUR
B. R. A. BIHAR UNIVERSITY
Dr. Priyanka

Myoglobin

- Myoglobin (Mb) is monomeric O2 binding hemoprotein
- Found in heart and skeletal muscle.
- It has single polypeptide (153 A.As) chain with heme moiety.
- Myoglobin (mol. wt. 17,000) structurally resembles the individual subunits of hemoglobin molecule
- Myoglobin functions as a reservoir for oxygen.
- It serves as oxygen carrier that promotes the transport of oxygen to the rapidly respiring muscle cells

Binding of O_2 to haemoglobin

- **One molecule of Hb can bind with four molecules of O_2.**
- **Myoglobin (with one heme) which can bind with only one molecule of oxygen.**
- **In other words, each heme moiety can bind with one O_2.**

Transport of O_2 by haemoglobin

- It can **transport large quantities of oxygen**
- It can **take up and release oxygen at appropriate partial pressures**
- It is a **powerful buffer.**

Oxygen Dissociation Curve (ODC)

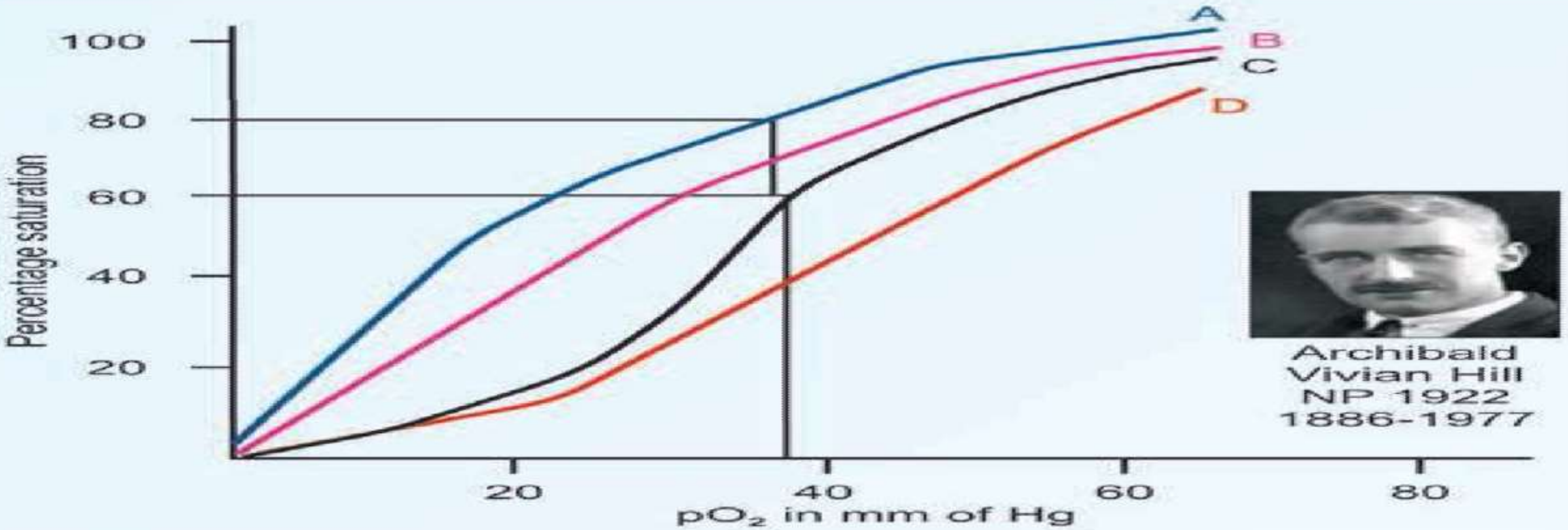
- The binding ability of hemoglobin with oxygen at physiological pO2 (partial pressure of oxygen) is shown by the oxygen dissociation curve (ODC)
- At the oxygen tension in the pulmonary alveoli, the Hb is 97% saturated with oxygen.

M.SC Semester III
Core Course XI
Bio-Inorganic Chemistry

TOPIC:-Unit III, Oxygen dissociation curve (ODC)

Department of Chemistry
L.S COLLEGE MUZAFFARPUR
B. R. A. BIHAR UNIVERSITY
Dr. Priyanka

Oxygen dissociation curve (ODC)



A—Theoretical curve as per mass action. B—Sigmoid curve, due to heme-heme interaction (Hill effect). C—Further shift to right due to carbon dioxide (Bohr effect) and BPG. This curve represents the pattern under normal conditions. D—Further shift to right when temperature is increased to 42°C.

Christian
Bohr
(1855-1911)

Factors affecting oxygen dissociation curve

- **Heme-heme Interaction & Cooperativity:**
- The oxygen dissociation curve (ODC) is sigmoid shape.
- The binding of O2 to one heme residue increases the affinity of remaining heme residues for O2.
- Thus the affinity of Hb for the last O2 is about 100times greater than the binding of the first O2 to Hb.
- This is called positive cooperativity

- Release of O_2 from one heme facilitates the release of O_2 from others.
- The quaternary structure of oxy-Hb is described as R (relaxed) form; & deoxy- Hb is T(tight) form.

2α +2β (Deoxy-Hb – T-form) → 2α,β (Oxy-Hb – R-form)

T and R forms of hemoglobin

- The four subunits (α2β2) of hemoglobin are held together by weak forces.
- The relative position of these subunits is different in oxyhemoglobin compared to deoxyhemoglobin.
- T-form of Hb:
- The deoxy form of Hb exists in T or taut (tense) form.
- The H & ionic bonds limit the movement of monomers.
- The T-form of Hb has low oxygen affinity.

R-form of Hb

- The binding of O_2 destabilizes some of the hydrogen & ionic bonds particularly between αβ dimers.
- This results in a relaxed form or R-form of Hb
- Therefore, the R-form has high oxygen affinity.

Transport of CO_2 by hemoglobin

- In aerobic metabolism, for every molecule of O_2 utilized, one molecule of CO_2 is liberated.
- Hemoglobin actively participates in the transport of CO_2 from the tissues to the lungs.
- About 15% of CO_2 carried in blood directly binds with Hb.
- The rest of the tissue CO_2 is transported as bicarbonate (HCO_3).

- CO_2 molecules are bound to the uncharged α-amino acids of hemoglobin to form carbamyl hemoglobin.
- The oxyHb can bind 0.15 moles CO_2/mole heme, whereas deoxyHb can bind 0.40 moles CO_2/mole heme.
- The binding of CO_2 stabilizes the T(taut) form of hemoglobin structure, resulting in decreased O_2 affinity for Hb.

Hemoglobin also helps in the transport of CO_2 as bicarbonate

- CO_2 enters the blood from tissues, the enzyme carhonic anhydrase present in erythrocytes catalyses the formation of carbonic acid (H_2CO_3).
- Bicarbonate (HCO_3^-) & proton (H^+) are released on dissociation of carbonic acid
- Hb acts as a buffer & immediately binds with protons

- Every 2protons bound to Hb, 4oxygen molecules are released to the tissues.
- In the lungs, binding of O_2 to Hb results in the release of protons.
- The bicarbonate & protons combine to form carbonic acid.
- Acted upon by carbonic anhydrase to release CO_2, which is exhaled