STRUCTURE AND FUNCTION OF HEMOGLOBIN, TRANSPORT OF O_2 AND CO_2 IN MAMMALS, BOHR AND HALDANE EFFECT, CHLORIDE SHIFT (PART-1)

Q.What do you mean by T and R form?

The quaternary structure of hemoglobin consists of a globular tetrameric molecule (5×5.5×6.4 nm) made of two pairs of peptide chains, each with its individual folded and coiled secondary-tertiary structure and its own heme prosthetic group. The peptide chains are held together and the quaternary bonds and some hydrogen bonds and electrostatic bonds (salt bridges).

About 97% of the hemoglobin of normal adult human consists of (HbA). Its globin consists of two α and two β peptide chains. Electrostatic bonds or salt bridges, involving the C-terminals of all four peptide chains, hold the quaternary structure of deoxygenated or partially oxygenated form, that is known as T form or Taut form.

With the progressive oxygenation of the four subunits of HbA, these salt links are progressively weakened and broken. This changes its quaternary structure from the T form to a form known as relaxed or R form. The T state has a less of an affinity for oxygen than the R state.

Q.What is Bohr effect?

Rise in PCO_2 shifts the O_2 dissociation curve of hemoglobin to the right, reduces the oxygen-affinity of hemoglobin increases P_{50} of hemoglobin and lowers its oxygen saturation, promoting the release of O_2 from oxyhemoglobin This is called **Bohr effect.**

It is responsible for enhancing the release of oxygen from oxyhemoglobin in active tissues with high PCO_2.

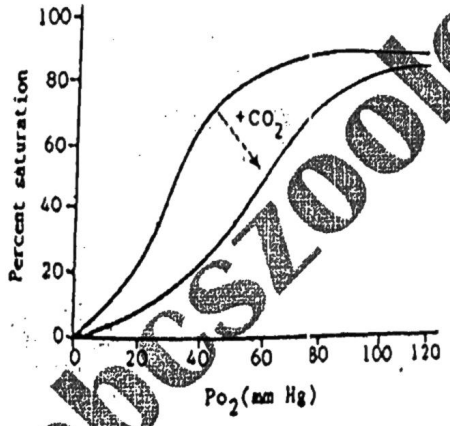

Figure: Bohr effect of PCO_2 on the O_2 dissociation curve f HbA.

Q.What is t

[Key: CO_2- dissociation curve]

a)CO_2 is hydrated into H_2CO_3 dissociates into HCO_3^- and H^+. The protons released from H_2CO_3 bind to the nitrogens of C-terminal histidine residues of the β chains of oxyhemoglobin. This protonation helps to re-establish the salt bridges between the peptide chains of hemoglobin, favouring the transition of its R form with higher O2 binding capacity to the T form with much lower O_2-binding capacity to the T form with much lower O_2-binding capacity. This consequently releases O_2 from oxyhemoglobin.

b))Effect of 2,3-DPG (2,3-diphosphoglycerate)—

i)Ascent to high altitude, exercise, anemia, chronic hypoxia and alkalosis increase the concentration of 2,3 DPG in erythrocytes. It is highly charged anion can bind to only the deoxygenated or T form of hemoglobin, but not to R form.