NOVEMBER 28, 2021

[INORGANIC CHEMISTRY IN BIOLOGICAL SYSTEM]

[B.SC – III (HONS)]

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INORGANIC CHEMISTRY IN BIOLOGICAL SYSTEMS:-

Biological importance of Na and K –

- Living organism require at least 27 elements, of which 15 are metals. Metals required in major quantities are K, Mg, Na and Ca minor quantities of Mn, Fe, Co, Cu, Zn and Mo and trace amounts some organisms.
- Bulk quantities of Group 1 and 2 metals are required, mainly to balance the electrical charges associated with negatively charged organic macromolecules in the cell and also to maintain the osmotic pressure inside the cell, to keep it turgid and prevent its collapse.
- The biological functions of Na and K are very different, Na^+ ions are actively expelled from cells where as K^+ are not. This ion transport is some times called a sodium pump and it involves both the active expulsion of Na^+ and active take – up of K^+.
- In animal cells the concentration of K^+ is about 0.15m and the concentration of Na^+ is about 0.01m. in body fluids (lymph and blood) the concentrations of K^+ and Na^+ are about 0.003m and 0.15m respectively.
- The transport of ions requires energy and this is obtained by the hydrolysis of ATP. It is estimated that hydrolysis of are ATP molecule to ADP provides enough energy to more three Na^+ ions out of the cell and two K^+ and are H^+ ions back in to the cell. The mechanism for ion transport – involves poly ethers natural to the organism.

- The different ratio of Na to K' inside and outside cells produced on electrical potential across the cell members. Which is essential for the functioning of nerve and muscle cells.
- The movement of glucose into cells is associated with Na^+ ions, they enter the cell together. This is favour by a high concentration gradient. The Na^+ ions entering the cell in the way must then be expelled. The movement of amino acids is similar.
- K^+ ions inside the cell are essential for the metabolism of glucose the synthesis of proteins and the activation of some enzymes.

Biological importance of Iron (Fe):-

This is essential in small amount for both plant and animal life; however. It is toxic in larger quantities. Biologically iron is most importance transition element, it involved in several different process, which are given below.

(1) As an oxygen carrier in the blood of mammals, birds and fish in the from of Haemoglobin.

(2) For oxygen storage in muscles tissue, in the form of myoglobin.

(3) As an electron carrier in plants, animals and bacteria in the form of cytochromes and for electron transfer in plant and bacteria in the form of ferredoxins.

(4) As for storage an scavenging of Fe in animals in the form of ferritin and transferrin.

(5) As nitrogenase, which is an enzyme in dinitrogen fixing bacteria.
(6) As a number of other enzyme for examples –
(a) Aldehyde oxidase, it oxidises aldehyde.
(b) Catalase and peroxide, it decomposes H_2O_2.
(c) Succinic dehydrogenase, it performs aerobic – oxidation of carbohydrate.

"Haemoglobin"

The human contains about 4 gm of iron about 70% of is found as haemoglobin. Haemoglobin is red pigment in the carry RBC.

The function of haemoglobin is to pick – up O_2 at the lungs. Now the arteries carry blood to that part of the body. Where O_2 is required. Here O_2 is transferred to myoglobin molecule and stored until the O_2 is required to release energy for glucose (sugar). When O_2 is removed to haemoglobin it is replaced by a water molecule. Next the protein part of haemoglobin absorb H^+ ion which comes from ionization of H_2CO_3. (Dissolve), Thus haemoglobin indirectly help to remove CO_2 form tissues, in the following manner.

Dissolve CO_2 i.e H_2CO_3 ionises as H^+ ion and HCO_3^- ion. Now haemoglobin pick – up this H^+ ion and HCO_3^- ion goes in to the solution in more soluble form. Now, the reduced haemoglobin and HCO_3^- both reach to the lung. Here in the lune haemoglobin give up H^+ ion and this H^+ ion

after combining with HCO_3^- (present in the soluble part of the blood) to give again H_2CO_3 (soluble CO_2). Now this H_2CO_3 gives CO_2 to exhale air.

In this way haemoglobin acts as direct carrier of O_2, but indirect carrier of CO_2.

The oxygenated part of haemoglobin is called as oxyhaemoglobin and reduced formed is deoxyhaemoglobin (the oxidation state of iron in haemoglobin +2).

Other group such as CO, CN^-, PF_3 etc can occupy the O_2 site, because these ligands are much more stronger than O_2 ligand. Thus, due to presence of these unwanted ligands may cause death, CN^- also interfere the cytochrome enzyme system which is principle, region for its extreme toxicity.

Haemoglobin has a molecular weight nearly 65000 and it is made sub town subunits, each ubuntu comprises a porphyrin complex haem, certain Fe^{2+} bonded to four N – atom and a globulin protein globin. The globin Coordinates to Fe^{+2} in haem through N – atom. The sixth position round the Fe^{+2} is occupied by O_2 molecule or H_2O molecule. Four subunits of haemoglobin called haem a attached with each other with the help of hydrogen bonding and hence, its O_2 attraction ability increases 4 – times. This phenomenon is co – operative effect. As the value of pH of blood decreases, the affinity of O_2 of blood decreases but as the blood is buffered this has only a slight effect.

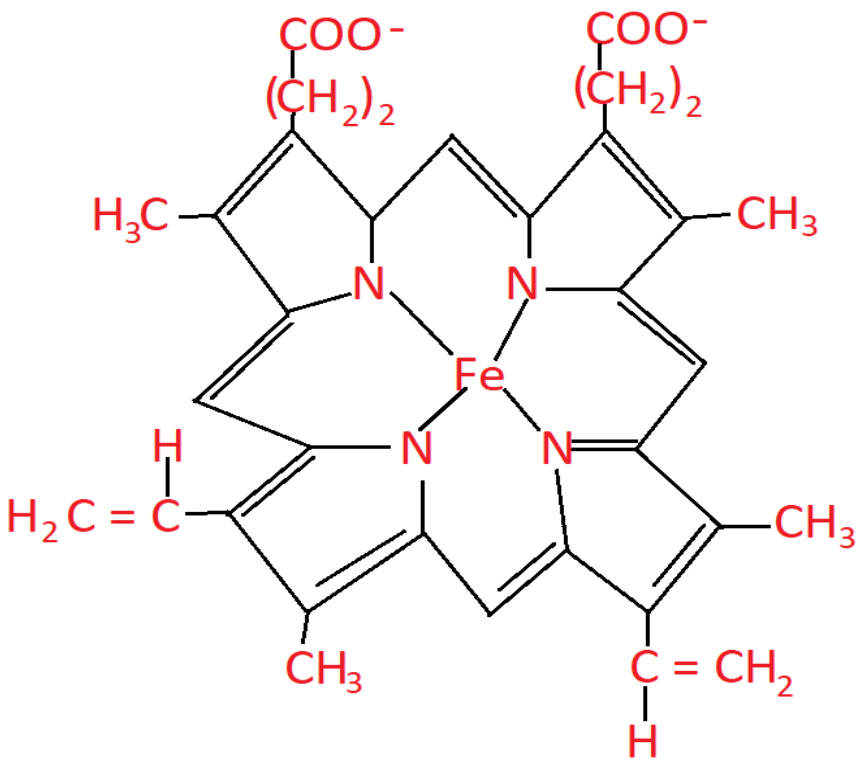

Fig :- Structure of Haem

"Myoglobin"

Myoglobin is used to store O_2 in muscles myoglobin is similar to one of the unit of haemoglobin. It contains only one Fe – atom. It has molecular weight 17000 and binds O_2 more strongly than haemoglobin.

"Cytochromes"

Cytochromes are divided in to three groups.

(i) Cytochrome a
(ii) Cytochrome b
(iii) Cytochrome c

In all cytochrome four haem units are present. It has molecular weight 12400. As in haemoglobin Fe is bonded with four preparing ring and fifth site is occupied by N – atom from the associated proteins the big difference is tat

the position is occupied by S – atom of methionine. Which is part of cytochrome.

Cytochrome are involved in release of energy by oxidising glucose with molecular O_2 in the mitochondria inside dividing cells.

Here, Fe – atom changes to ii – state to iii – state, reversibly. The energy is sored in to from of ATP (adenosine triphosphate) which is used when required by the cell.

Biological importance of cobalt (Co):-

(i) Cobalt is biologically important in some enzyme. eg – glutamic, these is involved in the metabolism of amino acids and ribonucleotide reductase in the biosynthesis of DNA.

Traces of cobalt is essential in diet of animals. Some sheep raised in Australis, New Zealand, Florida and Britain suffered from a deficiency disease. Which was traced to them grazing on cobalt deficiency soil. This can be remedied either by treating the soil periodically or by forcing the animals to swallow palette of cobalt.

Larger amounts of cobalt (Co) appear to be harmful. Traces of Co (1 – 1.5ppm) are added to been to make it froth better. This has been linked with an increased rate of heart failure among heavy been drinkers who have a dietary

deficiency of protein (or thiamine).

(ii) Vitamin B_{12} is an important cobalt complex. The vitamin was isolated from lives after was found that eating large quantities of row liver after was affective treatment of pernicious. Anaemia (Deficiency of blood). Injection of vitamin B_{12} are now used for treatment. Here in vitamin B_{12} cobalt is present in +3 oxidation state.

(iii) Methylcobalamin is important in the metabolism of certain bacteria which produce methane.

Biological importance of calcium (Ca):-

Ca^{+2} is concentrated in body outside the cell. Ca^{+2} is important in bones and teeth as apatite, mineral, $Ca_5(PO_4)_3$, OH, F Cl, $[Ca_3(PO_4)_2]$ and the enamel of teeth fluorapatite $\{3[Ca(PO_4)_2]CaF_2\}$. Ca^{+2} ion are important in blood clotting and to trig the contraction of muscle and to maintain the regular beating of the heart.

Biological importance of Magnesium (Mg):-

Mg^{+2} ions are concentrated in animal cells Mg^{+2} ion from a urea with ATP (Adenosine Triphosphate). And are constituents of phosphate hydrolases and phosphotransferases which are enzymes for relative involving ATP and energy release. They are also essential for.