Biological Role of Transition metals

Many transition metals have important role as trace elements (Fe, Cu, Zn, V etc) and ultratrace elements (Mn, Cr, Mo etc) in the biological system. Most of them acts as cofactor (metal ion as prosthetic group) in enzymes. These enzymes are known as metalloenzymes.

(A) Iron - Fe

Biologically iron is most important transition metal. It is a important trace metal required for the growth and survival of the organism. An adult with 70 Kg body weight carries 4.3 g of iron. Of the total iron in the human body about 70% is present in the erythrocytes of blood as constituent of haemoglobin and about 3-4% in myoglobin and ~~rest~~ in other haemoproteins like cytochrome xanthine oxidase, peroxidase etc. Most of the remaining ~~Meat, pulse and~~ iron is stored as non haem iron in ferritin and haemosiderin, transferrin etc.

Meat, pulse and leafy vegetables are the source of iron in the ferric form bond to proteins or organic acids. The Fe^{3+} ion is released from food in the acidic medium provided by gastric HCl. Reducing substances like ascorbic acid (Vit. C) and cysteine convert

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Fe^{3+} to Fe^{2+}. The ferrous form is absorbed by the body (stomach and duodenum). The Fe^{2+} entering the mucosal cells by absorption is oxidised by the enzyme ferroxidase to Fe^{3+}. This combine with apoferritin to form ferritin which is the temporary storage form of iron in liver and bone marrows.

Iron is mainly involved in oxygen transport and storage process in higher animals such as:

i) oxygen carrier in blood of animals, birds and fishes (haemoglobin)

ii) oxygen carrier in muscle tissue (myoglobin)

iii) an electron carrier in plants, animals and bacteria (cytochromes) and for electron transfer in plants and bacteria (ferredoxin)

iv) for storage and scavenging of iron in animals (ferritin and transferin)

(B) Copper - Cu

Copper is the third most biologically important metal after iron and zinc. It is constituent of several proteins and enzymes such as,

1) Amine oxidase - oxidation of amines
2) Ascorbate oxidase - oxidation of ascorbic acid
3) Cytochrome oxidase - acts with haem as the terminal oxidase step.
4) Glactose oxidase - oxidation of hydroxy group to aldehyde group in monosaccharide glactose.
5) Lysine oxidase - affects the elasticity of arotic walls
6) Dopamine hydroxylase - affects brain function.
7) Tyrosinase - affects skin pigmentation.
8) Ceruloplasmin - Plays a role in iron metabolism.

Copper is thus involved in a number of metabolic functions.

About 60-100 mg of copper is present in an adult human distributed over various organs. The dietary requirement of copper is nearly 2-3 mg per day, supplied by green leafy vegetables, cereals, nuts, eggs meat etc. It is absorbed in intestine and carried to liver. Most of the copper is incorporated into ceruloplasmin which enters the blood stream.

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Deficiency of copper causes demineralisation of bones, anemia, fraglity of artres, decolouration of skin and hair and several other disorders. The excess deposition of copper in human body causes a disease known as Wilson disease, probably due to failure in synthesing ceruloplasmin or the binding of metal to this protein.

Haemocyanin is the nonhaem ~~protein~~ copper protein which is important as an oxygen carrier in somer invertebrate animals. Haemocyanin is found in the blood of snails, crabs, lobsters, octapuses and scorpions. The oxygenated haemocyanins are blue coloured have one oxygen molecule attached to two copper atoms. Deoxygenated haemocyanin contains Cu(I) and also blue.

Plastocyanin occurs in chloroplasts of green plants. It is important in photosynthesis as an electron carrier. Azurin is found in bacteria. It contains one copper per molecule and is structurally similar to plastocyanin