METABOLIC FUNCTIONS OF MICRO NUTRIENTS

The essential minerals are associated with functions of specific organic molecules mostly the proteins. These minerals act as cofactor for many enzymes. The trace elements that are nutritionally essential are localized to fourth and fifth rows of the periodic table. The elements that are required more than 1 mg daily are referred to as macro-elements and the elements that are required in micrograms or in nanograms are called micro-elements.

Macroelements: Ca, P, Mg, Na, K, Cl, S.

Microelements: Fe, Cu, Zn, Co, Mo, F, I, Mn.

COBALT

The cobalt is associated with the vitamin B12. The cobalt is mainly associated with erythropoiesis, granulopoiesis and glucose homeostasis. The Vitamin B12 is coenzyme of the two enzymes namely methylmalonyl CoA mutase and 5`methyl-tetra hydrofolate homocystein methyl transferase.

1. Methylmalonyl CoA mutase: this enzyme participates in a pathway that converts propionyl CoA to Succinyl CoA (glucose homeostasis).
2. 5`methyl-tetra hydrofolate homocystein methyl transferase: this enzyme generates methionine and tetrahydrofolate.

COPPER

In adult animals, one third of the copper of the total body copper is found in the liver and brain. The ruminants have a high storage capacity of copper in their liver, often exceeding the two third of the total body copper. The copper has two major functions:

1. It acts as structural component of macromolecules acting as coordination centre.
2. It acts as cofactor for redox enzymes such as oxidases and mono-oxygenases that are essential for life.

MANGANESE

Mn functions both as an enzyme activator and as constituent of metalloenzymes. Various enzymes that are activated by Mn include hydrolases, kinases, decarboxylases, transferases. E.g. the enzyme xylose transferase that is responsible for transfer of xylose to cartilage is activated by Mn. The Mn deficiency causes deficiency of xylose in cartilage.

MOLYBDENUM

The most important function of Molybdenum is that it acts as cofactor for Xanthine oxidase, aldehyde oxidase, and sulphite oxidase. The enzyme Xanthine oxidase causes degradation of purine to uric acid that is hampered during Molybdenum deficiency.

The aldehyde oxidase is required by mainly ruminants to catalyze exogenous pyrimidines. The sulphite oxidase is a mitochondrial enzyme needed for oxidation of sulphite to sulphate during degradation of S-containing amino acids.

SELENIUM

The best known function of Se is as a component of Gluthione peroxidase that causes reduction of hydrogen and organic peroxides. The peroxides cause oxidative damage to biomolecules and biological membranes. Secondly Se is also a part of enzyme deiodinase that converts thyroxin to its active product tri-iodothyronine.

ZINC

Zinc is a cofactor for more than 200 enzymes. The Zinc cofactor enzymes are found in all the major pathways of carbohydrates, lipids, proteins and nucleic acid metabolism. The Zinc also stabilizes the structures of DNA, RNA, and ribosomes. Many DNA binding proteins contain Zinc. Thirdly Zinc is required for stabilization of biological membranes. The Zinc deficiency contributes to weakness of membranes. The most readily observable effect is weakness of membrane of RBCs causing haemolysis.

IRON

1. The iron is a part of cytochromes that carries out the cellular respiration in mitochondria.
2. Iron is present in haem part of haemoglobin that helps in carrying oxygen from lungs to tissues.

Iron can exist in two oxidation states Fe^{2+} and Fe^{3+}. The ability of iron to exist in tow oxidation states enables it to perform multiple functions. The iron containing proteins are involved in transport of oxygen, DNA synthesis, TCA cycle and various other enzymatic reactions. The iron is absorbed from small intestine and transferred to plasma where it is bound to a protein called transferin. 75% of the iron present in plasma is transported to the bone marrow for incorporation into haemoglobin in developing erythroid cells. The remaining plasma iron is taken up by non-erythroid tissues, mainly the liver.

IODINE

The Iodine can be absorbed in any of its soluble form. It is absorbed mainly by the intestine in the form of iodide (I^-) or iodates (IO_4^-). In ruminants, 70-80% of iodine is absorbed through rumen. The iodine is a part of thyroxin. The thyroid hormones exists in two forms namely T_3 and T_4.

Functions:

1. The hormone T4 carries out the uncoupling reaction respiratory chain decreasing P:O ratio. As a result more oxygen is required to produce similar amount of ATP.
2. The hormone T_3 stimulates the mRNA transcription and translation leading to increased protein synthesis.
3. T_3 and T_4 stimulate the sodium pump at the cell membrane.

FLUORINE

In the body the fluoride is mainly derived from water. About 95% of fluorides are present in bones and tissues and the remaining fluorides are distributed in soft tissues.

1. Prevents metabolism of bacterial cells growing on teeth causing tooth infections.
2. Retards osteoporosis.
3. Required for tooth development and bone development.
4. Powerful inhibitor of several magnesium activated enzyme concerned in phosphate metabolism.

Students are advised to study the books for details.

Recommended book is TEXTBOOK OF VETERINARY BIOCHEMISTRY, R.S DHONOTIA