

BIHAR ANIMAL SCIENCES UNIVERSITY

BIHAR VETERINARY COLLEGE, PATNA

Department of Animal Nutrition (ANN-602)

UNIT-I (ANIMAL NUTRITION- Mineral, vitamins and Feed Additives)

Lecture on

Trace Mineral (Copper and Cobalt)

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Copper

- In 1928, Hart and his associates discovered that a small amount of Copper is necessary along with iron, for haemoglobin formation.
- It is not a constituent of hemoglobin, but it does occur in Haemocuperin in blood cells.
- In certain invertebrates copper is present in hemocyanin that function as an oxygen carrier.
- After absorption from the upper section of small intestine, copper becomes loosely bound to serum albumin and amino acid and transport throughout the body.
- Liver is major storage organ.
- Normal copper concentration is 0.1 mg/ 100 ml of blood.
- Animal kept on forages containing copper below 7 mg per kg of DM exhibit copper deficiency.
- Copper is released from the liver primarily for hepatic synthesis of ceruloplasmin(CU-metalloprotein) , for synthesis of erythrocuprein and for incorporation into many enzyme.

Specific functions of Copper

- The role of copper in iron metabolism is incompletely understood. When copper is deficient in the diet, there is a decreased of iron, a lowering of its total content in the body, a decrease in its mobilization from tissues, and the development of a severe microcytic hypochromic anaemia.
- To play important role in hemoglobin synthesis and in red cell maturation.
- Iron is absorbed as Fe^{++} and transported as Fe^{3+} and that the conversion requires a copper dependent enzyme such as ferroxidase II .
- It is an integral part of many metalloenzymes such as cytochrome C oxidase, Uriases, Tyrosinase, lysyl oxidase, benzylamine oxidase, diamine oxidase, ascorbic acid oxidase etc.

- Copper is also important for normal bone formation as it is essential for osteoblastic activity and for normal collagen and elastin formation.
- It also occurs in certain respiratory pigments as well as hair and feather pigments.
- Approximately half of the total body supply of copper is found in the muscle mass. Stores are also present in the bone marrow, liver, and to a lesser extent elsewhere.
- Copper regulate lipid metabolism and has bactericidal properties at the intestinal level.
- Milk is deficient in copper just like iron.

Symptoms of copper deficiency

- Symptoms of deficiency vary among species.
- General symptom is ANAEMIA.
- Depressed growth.
- Bone abnormalities.
- Depigmentation of hair, feather and wool.
- Defective keratinization of wool.
- Fibrosis of the myocardium.
- Souring or diarrhea.
- Myelin aplasia of the spinal cord.
- Copper content of blood, liver, spleen and hair decreased.

Effects of Deficiency and Deficiency Diseases

- When copper is deficient in diet, there is a decreased absorption of iron, a decrease in its mobilization from the tissues and development of MICROCYTIC and HYPOCHROMIC ANAEMIA in Pigs and Chicken.
- Microcytic and Normochromic anaemia in calves.
- Depigmentation of coloured hair and black wool due to a defect in melanin synthesis because of a reduced TIROSINASE activity.
- Decreased wool growth, development of Stringy and Steely wool.
- ENZOOTIC ATAXIA(In Australia)(Neonatal ataxia) or SWAYBACK(IN England) – its occurs in lamb, kids and calves. Ataxia is caused by myelin aplasia rather than myelin degeneration and is associated with degeneration of motor neurons of the brain and spinal cord.

- Falling Disease – A chronic copper deficiency cause this disease in grazing cattle in Australia. This is characterized by staggering, falling and instantaneous death due to heart failure because of atrophy of myocardium.
- Scouring disease or lechsucht is wasting disease of cattle and sheep observed in north Europe. This is characterized by diarrhea, loss of appetite and anaemia. It is also known as copper pine.
- Copper deficiency can affect bone formation in at least two ways
 - (a) Decreased osteoblastic activity which means lack of bone matrix formations.
 - (b) A reduction in lysyl oxidase activity which leads to diminished stability and strength of bone collagen because cross linkage is impaired.

Copper deficiency in chickens

- Dissecting aneurysm of the aorta.

Aneurysm – deficient chicks show an absence of amine oxidase in the aorta and liver. This enzyme necessary for the incorporation of lysine into elastin of the aorta. thus the copper deficiency produces a lack of amine oxidase, an enzyme required for the formation of normal elastin in the aorta and resulting weak aorta, is subject to rupture of the inner coat and formation of aneurysm.

- Impaired reproduction – Low fertility characterized by delayed or depressed oestrus occurs.

Interaction Among Cu- Mo- S

- There is interaction among copper, molybdenum and Sulphur.
- Copper antagonists such as molybdenum and zinc may also be obtained by ingestion of soil rich in these minerals.
- High molybdenum and sulfate content of forage causes copper deficiency in grazing animal, even when the forage contains more than adequate levels of copper.
- High level of zinc and cadmium depress copper absorption.
- Silver, calcium carbonate, ferrous sulphide and calcium phytate interfere with copper absorption.

Copper Toxicity

- It is rare in most animals when adequate iron and zinc are present in the diet.
- Copper poisoning can occur in humans where there is continuous ingestion of copper from an industrial hazard.
- Sheep are more susceptible to copper toxicity than any other farm animal.
- Pigs are highly tolerant while cattle and goats are less tolerant.
- Palm kernel cake (PKC) feeding causes copper toxicity in sheep, in Australia feeding of sheep with 30 mg/ day caused haemolytic jaundice.
- Copper toxicosis occurs as a familial copper storage disorder with liver and kidney injury as in Wilson's disease in man.

