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Lecture title: **Animal nutrition: Copper and Iodine**

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Summary:

Copper

Copper is important in animal nutrition, it is necessary for hemoglobin formation ,It is present in certain other plasma proteins, such as ceruloplasmin, concerned with the release of iron from the cells into the plasma.Copper is a component of other proteins in blood. One of these, erythrocuprein, occurs in erythrocytes, where it plays a role in oxygen metabolism. It is also playing a vital role in many enzyme systems, for example:

- **Cytochrome oxidase** which is important in oxidative phosphorylation
- **Superoxide dismutase** which forms part of the cell's antioxidant system.

Copper also occurs in certain pigments as turacin, a pigment of feathers. It is necessary for the normal pigmentation of hair, fur and wool.Also copper is an essential component of hemocyanin (a protein pigment), which is not bound to blood cells but is suspended in the hemolymph to carry oxygen to tissues.Copper particularly concentrated in the liver, which acts as the main copper storage organ of the body. It has an antimicrobial effect to inhibit the growth of molds, fungi, algae, and harmful microbes and reduce the susceptibility to infection in lambs directly.

Absorption of copper

In the lumen of the small intestine, Cu^{2+} is reduced to Cu^{1+}; both of them are absorbed into the enterocyte through copper transporter. Copper is absorbed by the small intestine into the portal vein. Many substances present in the diet affect the bioavailability of its copper. Specifically, copper from inorganic compounds is poorly absorbed in animals, The bile is the major pathway for the secretion of endogenous copper.

Sources of copper

The copper content of crops is related to some extent to the:

- Soil copper level
- Drainage conditions
- Herbage species.

Seeds and seeds by-products are usually rich in copper while straws contain little copper. The normal copper content of pasture ranges 4 - 8 mg/kg DM. The copper content of milk is low.

Deficiency symptoms

Copper deficiency can lead to many symptoms include :

1. Anaemia and poor growth
2. Bone disorders
3. Scouring, infertility
4. Depigmentation of hair and wool
5. Gastrointestinal disturbances
6. Affect wool production
7. **Enzootic ataxia** a condition have lesions in the brain stem and spinal cord. The lesions are associated with muscular incoordination and occur, especially, in young lambs. the disorder is associated with pastures low in copper content (2–4 mg/kg DM).
8. **Falling disease** was found to be related to a progressive degeneration of the myocardium of animals grazing on copper deficient pastures and high content of antagonistic minerals (e.g., molybdenum, sulfur, and iron).

Excess of copper

Copper is a strong oxidizing agent. Thus, its excess results in stomach pains, nausea, and diarrhea, as well as tissue injury and disease in animals.There are two forms of copper toxicity:

1-**Acute copper toxicity** results from exceedingly high consumption of copper from diets (e.g., 20–100 mg/kg diet in sheep and young calves, and 200–800 mg/kg diet in adult cattle).

2-**Chronic copper toxicity** occurs when high amounts of copper at doses below the acutely toxic level are consumed over a period of time.sheep are most susceptible to chronic copper toxicity. This is because ovine hepatocytes have a high affinity for copper and excrete copper into the bile at a low rate, leading to an accumulation of copper in the cells.

Iodine

The concentration of iodine present in the animal body is very small and in the adult is usually less than 600 µg/kg. its only known role is in the synthesis of the two hormones, triiodothyronine (T3) and tetraiodothyronine (T4, thyroxine) produced in the thyroid gland. The thyroid hormones accelerate reactions in most organs and tissues in the body, thus increasing the basal metabolic rate, accelerating growth and increasing the oxygen consumption of the whole organism. They also control the development of the fetus and are involved in immune defense, digestion, muscle function and seasonality of reproduction. Dietary concentrations assuming a normal daily DM consumption lay between 0.05 and 0.10 mg/ kg DM for poultry depending on environmental temperature, rate and stage of production and the efficiency of energy utilization.

Absorption of iodine

Dietary iodine is converted into the iodide ion before it is absorbed by the stomach. iodine is absorbed very efficiently from the gastrointestinal tracts enables any iodine secreted prior to absorptive sites to be extensively recycled. iodine is recycled via secretion into the abomasum. Absorbed iodine is transported in the bloodstream loosely bound to plasma proteins.

Sources of iodine

Iodine present mainly as inorganic iodide, in which form it is absorbed from the digestive tract. The richest sources of iodine are foods of marine origin. fishmeal is also a rich source of iodine. The iodine content of land plants is related to the amount of iodine present in the soil, it can be supplemented in the diet as sodium or potassium iodide or as sodium iodate.

Deficiency symptoms

When the diet contains insufficient iodine, the symptoms include:

1. the production of thyroxine is decreased, and iodine deficiency impairs negative feedback control of pituitary gland activity, resulting in increased production of thyroid-stimulating hormone. The main indication of deficiency is an enlargement of thyroid gland, termed endemic goiter.
2. animals with iodine deficiency exhibit dry and scaly skin, stunted growth, excess fat deposition

3. Reproductive abnormalities, breeding animals deficient in iodine give birth to hairless weak or dead young calves with impaired brain development.

4.estrous is suppressed or irregular and male fertility is reduced.

Excess of iodine

Excessively high levels of iodine supplementation should be avoided in diets:

1. In pregnant ewes has resulted in lambs with a reduced ability to absorb immunoglobulins and vitamin E from colostrum.
2. In hens lead to early embryonic death, reduced hatchability.