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Lecture title: **Animal nutrition: Magnesium and Sulphur**

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Summary:

Magnesium

About 70 % of the total magnesium is found in the skeleton, Magnesium is the commonest enzyme activator, as in systems with thiamin pyrophosphate as a cofactor, it is essential for the efficient metabolism of carbohydrates and lipids because it's activated phosphate transferases, pyruvate carboxylase and pyruvate oxidase reactions of the tricarboxylic acid cycle. Magnesium is involved in cellular respiration and many other cellular reactions, forming complexes with adenosine tri-, di- and monophosphates. Magnesium ions moderate neuromuscular activity . Through binding to phospholipid, magnesium involved in cell membrane integrity. Magnesium involved in the interaction of parathyroid hormone, which is responsible for calcium mobilization.

Absorption of magnesium

In mono gastric animals' magnesium is absorbed from the small and large intestine. In ruminants, absorbability can be low, and potassium reduces the efficiency of absorption by inhibiting the two active transport systems in the rumen wall especially in sheep. High levels of fatty acids were thought to lower the magnesium absorption by forming insoluble magnesium soaps in the rumen, which were excreted in the faeces.

Sources of magnesium

- Wheat bran, dried yeast and most vegetable protein concentrates, especially cotton seed and linseed, are good sources of magnesium.
- Clovers are usually richer in magnesium than grasses.
- The mineral supplement used most frequently is magnesium oxide, which is sold commercially as calcined magnesite mixed with the concentrate ration.
- Alternatively, a mixture of magnesium acetate solution and molasses can be used.

Deficiency symptoms

Symptoms due to a deficiency of magnesium in the diet have been reported for a number of animals. the symptoms include:

1. increased nervous irritability and convulsions.
2. In calves caused low serum magnesium levels, depleted bone magnesium, tetany and death.
3. Colostrum is high in magnesium content, but milk is low in magnesium, and this is compounded by a reduction in the efficiency of absorption of magnesium as the calf ages.
4. In adult ruminants, a condition known as hypomagnesemic tetany, associated with low blood levels of magnesium, the condition known as grass tetany and can affect cattle and sheep. it is particularly common in the spring when the animals are turned out on to young pasture. there is evidence of a positive relationship between tetany and heavy dressings of pasture with nitrogenous and potassic fertilizers.

Excess of magnesium

Hypermagnesemia is defined as an abnormally high magnesium concentration in the plasma.it can result from excessive magnesium intake leading to reduced dry matter digestibility, reduced feed intake and impaired growth. When the ruminal fluid contains ≥320 µg/mL of magnesium this will be toxic to rumen flora and affect the rate of cellulose digestion**.**

Sulphur

Sulphur has long been recognized as an essential element for ruminal micro-organisms, and its metabolism is closely related to nitrogen metabolism. Most of the sulphur in the animal body occurs in proteins containing the amino acids (cystine, cysteine and methionine). vitamins (biotin and thiamin) , hormone (insulin) and metabolite coenzyme. The nutritive value of sulphur related to their availability for microbial protein synthesis. The structural compound chondroitin sulphate is a component of cartilage, bone, tendons and the walls of blood vessels. Only a small amount of sulphur is present in the body in inorganic form, sulfate (SO_4) particularly abundant in the keratin-rich appendages (hoof, horn, hair, feathers, wool fibre and mohair). Wool is rich in cystine and contains about 4 % of sulphur.

Recently ,with the increasing use of urea as a partial nitrogen replacement for protein nitrogen and as a method for treating cereal grains, it has been realized that the amount of sulphur

present in the diet may be the limiting factor for the synthesis in the rumen of cystine, cysteine and methionine, therefore the addition of sulphur to urea-containing rations is beneficial.There is evidence that sulphate (as sodium sulphate) can be used by ruminal microorganisms more efficiently than sulphur. The ratio of sulphur to nitrogen in microbial protein is 14: 1), The N: S ratio in wool protein is narrower, at 5: 1. Sulphur primarily will excrete via urine.

Sulfur in forages

The sulfur concentrations found in pasture depending mainly on the plant species, availability of soil sulfur, nitrogen and phosphorus, Application of SO_4 fertilizer increases herbage sulfur. Cereal grains tend to be low in sulfur while animal by-products are moderate sources.

Deficiency symptoms

1. Loss of appetite and digestibility, due to a failure to digest cellulose in sheep.
2. Sheep deprived of sulphur spend more time ruminating and increased rumen liquor volume.
3. Growth is retarded, wool or hair is shed, and the emaciated animal dies.
4. Diets low in sulphur enhance the tissue accumulation of cadmium.

Excess of sulphur

The largest tolerable limit for sulfur in beef cattle diets was 0.3% in diets containing greater than 85% concentrate. toxicity of sulfur occurs because of the following reasons:

- Formation of hydrogen sulfate (a toxic agent) by the gastrointestinal flora to kill bacteria and induce excessive production of reactive oxygen species to cause oxidative damage.
- Production of sulfuric acid to reduce pH in the ruminal fluid and host tissues.
- Chronic exposure to high sulfur intakes in the diet or drinking water can have adverse indirect effects on ruminants, particularly by inducing copper deficiency, reduced absorption of other minerals, such as zinc and manganese by the small intestine.