University of Mosul
Lecture No.: 5
College of Veterinary Medicine
Date: second term/ 2025
Unit of Scientific Affairs
Website: https://uomosul.edu.iq/veterinarymedicine/

Lecture title: **Animal nutrition: Iron and Cobalt**

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Summary:

Iron

More than 90 % of the iron in the body is combined with proteins, the most important being heme proteins include hemoglobin and myoglobin (which are used for O_2 binding, transport and storage) Iron also occurs in blood serum in a protein called transferrin, which is concerned with the transport of iron from one part of the body to another. Ferritin, a protein containing up to 200 g/kg of iron, is present in the spleen, liver, kidney and bone marrow and provides a form of storage for iron.Iron has a major role in biochemical reactions, particularly in connection with enzymes of the electron transport chain (cytochromes), the enzymes activated by iron are included Catalase, Peroxidases, phenylalanine hydroxylase and tricarboxylic acid cycle enzymes.Animals contain many non-heme iron enzymes, The iron in these enzymes is generally tightly bound to the sulfur atoms of cysteine residues. Hence, these enzymes are called "iron–sulfur proteins, these proteins are located in mitochondria, cytosol, and nucleus to exert their diverse functions.

Sources of iron

Iron is widely distributed in foods, but its content varies greatly. Concentrates, green leafy materials, and most leguminous plants generally provide sufficient quantities of iron for farm animals. Cereal grains contain (30–60 ppm). Feeds of animal origin such as blood and fishmeal, are excellent sources of iron. Ferritin a major form of iron in food legumes such as soybeans.

Absorption of iron

Iron is absorbed throughout the gastrointestinal tract. The efficiency of absorption is increased during periods of iron need and decreased during periods of iron overload.In the stomach, iron binds to a glycoprotein called gastroferrin, the iron-complexed gastroferrin flows into the duodenum along with food. In the lumen of the small intestine, Fe^{3+} is reduced

to Fe^{2+} by vitamin C or duodenal cytochrome. Fe^{3+} that is bound to mucins in the lumen of the small intestine enters the enterocyte through the mobilferrin-mediated ferric iron pathway.

Deficiency symptoms

Decrease hemoglobin synthesis and anaemia will result. Anaemia due to iron deficiency occurs most commonly in rapidly growing sucklings. animals with iron deficiency exhibit extreme fatigue, weakness, shortness of breath, dizziness, pale skin, chest pain, fast heartbeat. iron deficiency results from inadequate intake and impaired absorption of dietary iron, reduced availability of iron-binding and transport proteins due to protein malnutrition,When dietary iron is deficient, copper uptake by enterocytes and hepatocytes is elevated, Copper accumulation in the liver can stimulate the synthesis and release of ferroxidase, which catalyzes the oxidation of Fe^{2+} to Fe^{3+} in the plasma, Iron-deficiency anaemia is not common in lambs and calves because it is unusual to restrict them to a milk diet without supplementary feeding.

Note:

In some cases, chronic iron toxicity results in reduced growth and phosphorus deficiency.

Cobalt

Cobalt is required by microorganisms in the rumen for the synthesis of vitamin B_{12}, the ruminant required the vitamin because of its involvement in the metabolism of propionic acid, an important acid absorbed from the rumen. Ruminants have a higher requirement for cobalt than non-ruminants because some of the element is wasted in microbial synthesis of organic compounds with no physiological activity in the host's tissues. Cobalt is believed to active ion in certain enzyme reactions.

Sources of cobalt

Seafoods, meats (beef and poultry), liver, milk, yeast, and leafy vegetables are good sources of cobalt. The cobalt content of plants varies with their species and the cobalt content of the soil. The inorganic forms of cobalt include cobalt arsenide, cobalt oxide, cobalt sulfide, cobalt chloride, and cobalt sulfate . The organic form of cobalt in plants and animals is primarily vitamin B_{12}. Ruminants obtain cobalt from both forages and soil. However, the content of cobalt

in plants depends on their species (more cobalt in legumes than in cereals) and soil type.Normal pasture herbages have a cobalt content within the range of 100–250 µg/kg DM and most feeds contain traces of cobalt.

Absorption of cobalt

Absorbed cobalt enters the portal circulation. In the blood, non-vitamin B_{12} and vitamin B_{12} are carried, respectively, through albumin and specific binding proteins into tissues. In the rumen, bacteria take up cobalt through cobalt transporters 1 and 2 as well as an ATP binding cassette.

Deficiency symptoms

1. Vitamin B_{12} cannot be produced in the rumen in amounts sufficient to satisfy the animal's requirements.
2. Gradual decrease in appetite with consequent loss of weight
3. Severe anaemia.
4. Rapid muscular wasting
5. There is a general absence of body fat, but the liver may be fatty which is called White-liver disease (WLD) affected lambs are anorexic, anaemic and ill-thriven in appearance.

Excess of cobalt

Toxic threshold levels of dietary cobalt intake differ among animals: 0.5 for calves, 1.0 for cows, 2–3 for sheep, and 3.0–3.5 for chicks (mg/kg BW / day). Excess of Cobalt results in reduced feed intake, growth restriction, dermatitis, cardiomyopathy, and goiter. The mechanism of cobalt toxicity may involve free-radical generation and consequent tissue damage.