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AND DEFICIENCY SYMPTOMS OF LIVESTOCK'S
PRODUCTION.**

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MACRO (MAJOR) MINERAL, FUNCTION, SOURCE AND DEFICIENCY SYMPTOMS OF LIVESTOCK'S PRODUCTION.

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ABSTRACT

Apart from energy and protein, mineral constitutes a major role in production and reproduction of animals. Deficiencies of certain mineral elements may cause reproductive disorders as minerals play an important role in health and reproduction of the livestock. Infertility and reproductive disorders has emerged as an important problem in our livestock population. Adequate supplementation of minerals depends on age, stage of pregnancy

and lactation. Macro minerals and trace minerals are equally important as they take part in formation of structural component of body and proper functioning of enzymes, hormones, vitamins and cells. Mineral deficiency and toxicity is area specific. Minerals have beneficial or detrimental effects on animal physiological wellbeing, depending on its balance.

Keywords: Mineral, reproduction, infertility, macro, trace

INTRODUCTION

Almost all the 40 minerals so far identified in the nature have been deserved in the body of animals. All these 40 minerals are not essential for the normal body functions. Many minerals present merely due to their presence in natural foods/feeds, drinking water and environment (by inhalation). For the normal structural development and physiological functions certain minerals have proved to be essential; until 1950 only 13 minerals i.e calcium, phosphorus, magnesium, sodium, chloride, potassium, sulphur, iron, copper, cobalt, zinc, iodine and manganese were identified essential for the normal functions of animal body including humans. This list continued to increase with the advancement in mineral nutrition. Four more elements, i.e. thorium, fluorine, molybdenum and selenium were added during 1970. Later on eight more minerals were added in the necessary list. These are arsenic, boron, lead, lithium, nickel, silicon, tin and vanadium. Thus, in all 25 minerals have been found associated with physiological functions in the body. However, mechanism of functions is yet to be worked out for some of the later identified mineral nutrients. There is every chance of determination of some more minerals of



nutritional and physiological significance. Since many of the essential minerals particularly recently identified trace minerals are widely present in the natural sources of feeds and drinking water, the scope of occurrence of deficiency diseases is remote under normal conditions. The requirement is also very little. However, metabolic disturbances due to imbalance of ratio among some inter influencing minerals cannot be ruled out. In addition to aforesaid minerals there are many other minerals in feedstuffs, drinking water, dust, industrial fumes and effluent which are toxic on breaking the threshold limit or even otherwise. Higher uptake of some essential minerals also becomes toxic and produces harmful effects on health and production.

GENERAL FUNCTIONS OF ESSENTIAL MINERALS

The functions of essential minerals in the body are mostly interdependent and interrelated. The main functions of minerals may be classified into the following four broad groups.

1. Minerals as structural components are required for the formation and repair of worn out tissues.
 - a. Growth of bones, teeth and cartilage.
 - b. Formation of horns, antlers, hooves and body coat.
 - c. Component of blood and other body fluids.
 - d. Components of soft tissues.
 - e. Formation of feather and egg shells in birds and reptiles.
2. Regulatory roles in normal physiological functions:
 - a. The regulatory roles of minerals are managed by blood plasma, which is known as central compartment of

central reserve. Minerals in the central compartments, viz. digestive tract (readily mobilized compartment) and also from difficult to mobilized compartments like bones. There are also some smaller compartments of significant importance like enzymes, hormones and body fluids.

- b. The minerals are used in (1) ionic form, (2) molecular form and (3) conjugated forms in different kinds of physiological functions. Conjugated forms of minerals are present in (a) haem, (b) enzymes and (c) hormones.

(A) MACRO (MAJOR) MINERALS

The minerals are present in the body at large amount and which are required in relatively large amount for the synthesis of structural tissues. Their concentration is expressed in terms of percentage. Average tissue concentration of these compounds is over 0.01%. The minerals are calcium, phosphorus, sodium, potassium, magnesium, sulphur and chlorine.

CALCIUM (CA) AND PHOSPHORUS (P):

Major amount of calcium (about 98%) and phosphorus (about 85%) are present in the skeletal system of the body. Their absorption and utilization are interlinked. Phosphorus is associated with number of enzyme systems. Certain proportion of Ca and P along with vitamin D should present in the diet for proper absorption and utilization of both the minerals. The optimum ratio should be 1:1 to 2:1. The requirement of these minerals in growing and lactating animal is very high for their skeletal tissue growth and milk



production, respectively. Ca in the body remains indynamic state between blood and bone and their interchange depends upon the mineral status of the animals. In addition, at low dietary Ca level, animals absorb more Ca and vice-versa. Unlike Ca, a low dietary P level reflects the plasma inorganic P level. Therefore, bone mobiles Pand become fragile. For Ca absorption and utilization vitamin D is required.

Sources:-

The main foods rich in calcium are dairy products like milk, cheese and yoghurt. These include seafood, leafy greens, legumes, dried fruit, tofu and various foods that are fortified with calcium. However, cereal and roots are poor sources of Ca. However, many non-dairy sources are also high in this mineral. Forages are very satisfactory source of Ca. Concentrates are generally poor source of Ca, except sesame cake. Straws are generally poor source of Ca.

Functions of Calcium:-

1. In bone growth and mineralization: The 99% Ca in body is in the skeleton.
2. In muscle contraction: some physiological functions such as nerve conduction and muscle contraction and relaxation including heart muscle.
3. It activates and stabilizes certain enzymes in the body.
4. It also involve in the regulation of cell cycles
5. It is required for blood clotting: Calcium must be present to convert prothrombin to thrombin which reacts with fibrinogen to form the blood clot fibrin.

Deficiency Diseases:-

In growing animal and young one suffer from rickets which are characterized by mish bones, enlargement of the joints, lameness and stiffness. The long bones may be affected severely which caused bowed legs in human as well as non-ruminant. The deficiency in adult causes osteomalacia characterized by depletion of Ca for other important necessary functions during acute deficiency which makes the bone porous, fragile and weakening.

PHOSPHORUS (P)

Phosphorus has very specific function in animal body. The calcium and phosphorus work better in more close association. It is found in the every cells but the major portion of the phosphorus is found in combination with calcium in the bones and teeth. The phosphorus plays a very important role in energy metabolism of animal. Sources Like the calcium it is also present in dairy products like milk and milk product, meat and meat products, fish meal and cereal grains. The phosphorus is very less in hay and straw and other crop residue.

Functions:-

1. It is the useful mineral in the bone and teeth formation. About 80% of bodyphosphorus is found in the bone and skeleton as well as in the teeth. The rest 20% are widely distributed in the body fluids and soft tissues.
2. It is a constituent of the high energy compound Adenosine Tri phosphate (ATP): Phosphorus is a component of ribonucleic acids and de-oxy ribonucleic acids. Which are important in cell growth and cell differentiation.



3. It is also cellular constituents, i.e. phospholipids and it is active constituents of cellular permeability. As phospholipids, it contributes to cell membrane fluidity and integrity.
4. Maintain osmotic pressure and acid–base balance.

Deficiency Symptoms:-

Phosphorus is an important mineral and it is maximum in bone and maintains the integrity of bone. The deficiency of phosphorous causes abnormality in bone and teeth. In phosphorus deficiency, a disease known as pica which is characterized by abnormal food habit, the abnormal animals will take wood, sand, soil, bones, bags and other nonfood materials.

POTASSIUM (K)

Potassium is a very important element which regulates the osmotic pressure in the body fluids along with Na, chloride and bicarbonate ions. It is a chief cation of the intracellular fluids. Also this element is important for maintaining the acid–base balance. It plays the role in the carbohydrate metabolism and nerve and muscle excitability. Although potassium (K) is an essential nutrient for dairy cattle, increasingly high levels in forages have made cattle more susceptible to metabolic diseases such as grass tetany, udder oedema and milk fever. The potassium requirements vary depending on the different stages of the animals. It is reported that the feedlot cattle, range cattle and growing heifers require about 0.6% K in their diet.

The cattle lose K during its production and in the stress condition and harsh environment, the additional K supplements through diet is necessary to

provide. Lactating dairy cows require 1.2% potassium on a dry matter basis and the heat stressed dairy cows require about 1.5% K.

Potassium and sodium are cations, where as sulphur and chloride are anions. Therefore, when a diet has dietary cation–anion difference which increases Blood pH leads to a reduced Ca absorption from the gut and in bone mobilization. Due to low Ca absorption and due to cation and anion difference leads to the occurrence of milk fever in lactating animal.

Sources

Cereal grains contain about 0.5–0.8% K, where as forages generally contain higher than grains and it is around 1–3% K. However in forages, K content is extremely variable and is influenced by species/variety, plant maturity, soil type and fertilization. The legumes content high K as compared to Corn silage. The plant and grasses content of K is generally very high. Therefore, very rare chances of k deficiency occur in animals. High intake of potassium is easily excreted through urine.

Functions

Potassium maintain acid–base equilibrium and osmotic pressure, nerve transmission, carbohydrate and protein metabolism, heart beat relaxation, activates certain enzymes in animals.

Deficiency Symptoms

The deficiency of potassium cause general weakness of muscles, weak extremities, weak cardiac and respiratory muscles.



SULPHUR (S)

It is an essential element necessary in the ruminant and non-ruminant diet. The excess intake of sulphur causes toxicity in animals. This is an important nutrient required for normal growth and reproduction of bacteria in the rumen of cattle. It is very much necessary for synthesis of certain sulphur containing amino acids (cysteine, cystine and methionine) of rumen microbes. The sulphur is also important for synthesis of thiamine and biotin and necessary for enzymes activity.

Sources

Essential for growth and production of wool and milk, sulphur can be found in many animal feed sources, including water. Sulphur supplements may keep animals healthy when no natural source can be found. Sheep and goats typically require more dietary sulphur than cattle due to the large amounts of sulphur they require to grow hair and wool. Sulphur needs may increase during a wool-growing season. Increased sulphur intake is associated with higher lamb survival rates, up to 33% more wool production, weight gain and stronger wool. In dairy cattle, adequate amounts of sulphur improve the production of milk solids, milk fat, milk protein and milk casein, which leads to improved cheese production.

Toxicity of Sulphur The sulphur in excess causes toxicity. It causes imbalances in ruminal microbial metabolism which results in accumulation of sulphide in rumen. Non-reduced sulphur, i.e. sulphate and elemental sulphur are non-toxic. However, H₂S and its various ionic forms are toxic.

Deficiency Symptoms:-

1. Reduced Mohair production in Angora goats. Sodium sulphate and ammonium sulphate are used for ration formulation to ameliorate the deficiency.
2. Sulphur deficiency in ruminant causes reduction in appetite and also reduced cellulose digestion. The nitrogen :sulphur ratio is very important in ruminant and the ideal ration should be 10:1 to 15:1.
3. Rumen bacteria use inorganic sulphur to produce sulphur containing amino acids; deficiency of inorganic sulphur leads to deficiency of sulphur containing amino acids.

MAGNESIUM (MG)

The magnesium is an important major mineral and useful for enzyme activation in many important biological reactions in the body. The major portion of it is found in the bone formation in association with Ca and phosphorus. About 70% of the total Mg present in the bony structure, i.e. skeleton and teeth, and rest (30%) distributed in the soft tissues and fluids. This element is mainly enzyme activator and it activates the enzymes such as phosphate transferases, decarboxylases, acryl transferases, etc.

Sources

The magnesium is generally available in the forages and its concentration varies with species of the forage. Also the Mg content of the forage depends upon the soil, fertilization and the climatic condition in which the plants or forages are grown. The magnesium content in the leguminous plants is much higher than the grasses. Clovers are rich source of magnesium. However, seasonal variation not occurs in Mg content in forages.



However, the Mg in straw is less magnesium. The concentrate also varies widely in Mg content. Cereal grains are poor source of Mg as compared to oil cakes and fish meal. Wheat bran, dried yeast and most of the vegetable protein concentrates including linseed cake and cotton seed cake are the very good source of Magnesium.

Deficiency Symptoms

In ruminants, the deficiency of magnesium leads to the hypomagnesaemia or grass tetany. In goats, grazing on the early, lush pasture especially those heavily fertilized with K and nitrogen causes the Mg deficiency. The hypomagnesaemia tetany is known by various names like magnesium tetany, lactation tetany and grass staggers. The clinical signs in deficiency are accelerated breathing, hyper excitability and tremors followed by convulsion, coma and death. In case of ewes, the deficiency of magnesium may lead to rapid breathing, facial tremble, impaired movement, stiff movement and awkward gait. Ultimately it collapsed and occurred repeated tetanic spasm. Generally in magnesium deficiency, the sheep loose the appetite and it is due to rumen dysfunction. The loss of petite depends on the severity of deficiency of Mg. When the deficiency of the Mg is moderate, then the loss of appetite of the animal will be moderate.

SODIUM (NA) AND CHLORINE (CL)

The growth rate and fertility are drastically reduced in sodium deficiency; however, the chlorine is very important in gastric digestion. The sodium and chlorine combinedly constitute the common salt and it is very associated, one element deficiency is accompanied by others. The deficiency of common salt is characterized, by poor

appetite, weight loss, rough coat and drop in milk yield of the lactating animals.

Sources

The animal and its product especially meat meal, food of marine origin are good source of sodium and chlorine. In case of animal, the common salt is used to fulfil the Na and chlorine requirement. Most of the vegetable foods are low content of Sodium. The chlorine content in pasture varies and depends on the area and soil condition. As plant content less Na and Cl, therefore it is in practice to provide common salt supplementation to meet the need of Na and Cl.

Deficiency Symptoms

Sodium deficiency may lead to dehydration of the body. Symptoms include poor growth and lowering the utilization of digested carbohydrate and protein. Egg production and growth will be reduced in poultry. Due to deficiency of chlorine, an abnormal increase of alkali reserve in the blood.

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