## Minerals in Animal Nutrition

The periodic system lists 104 elements. There are about 40 mineral elements that occur in measurable mount in nature in the plants and animals tissues.

Minerals are generally

classified into two categories.

1-Macro elements (Major elemnts): The minerals, which ard required in relatively large amount and in most of cases they are used in te synthesis of structural tissues. Their

concertration is expressed in term of percentage. The important maor elements are calcium, phosphorus, magnesium, sodium, potassium, chlorine and sulphur.

2-Micro elements (Minor elements or trace elements): These minerals required in trace amounis and usually function as activators or as a component of enzyme system.

The concentration of tracelements is expressed in terms of part per million (PPM) since their concentration is very low in the plants and body. The important trace elements are iron, copper, iodine, cobalt, zinc, manganese, fluorine, selenium, molybdenum, chromium, nickel, silicon, tin and vanadium and play a functional role in animal physiology.

Essential mineral elements: These are those minerals, which have been proved to have a metabolic role in the animal body.

Non-essential mineral elements: Most of mineral elements are simply component of animal tissues since they are present in the diet and are considered to be non-essential, as they do not play any essential metabolic role in the plant or animal body.

General Function of Minerals : The functions of minerals in animal nutrition are interrelated. However, a few of the general functions are given as:

1: As a constituent of skeletal structure.

2: In regulating acid-base equilibrium.

3:They are helpful in maintaining the colloidal state of body matter and regulating some of the physical properties of colloidal systems like viscosity, diffusion and osmotic pressure.

4: They act as a component or an activator of enzymes and or other biological systems.

## MACRO-ELEMENTS(MAJOR ELEMENTS):

All the macrominerals are discussed here reference to their function, metabolism, deficiency symptoms and sources of these minerals.

1:Calcium: calcium and phoshphorus serve as the major structural elements of skeletal tissue, with more than 99 per cent of the total body calcium being found in the bone and teeth . The normal level blood calcium in animals ranges from 9 to 11 mg per 100ml of serum.

The cellcontains negligible amounts .

From 45-50 per of the plasma calcium is in the soluble, ionized form, while 40-45 per cent is bound win protein, primarily albumin and other plasma protein. The remaining 5per cent is complexes with non- ionized inorganic elements depending hens contains 30 to 40 mg calcium per 100 ml of blood.

factors affecting the level of blood calcium:

1. The absolute levels of calcium and phosphorus and the calcium phosphorus ratio of food: A low intake of either element over long periods of time leads to decreased blood calcium level. A Ca : P ratio of 1:1 to 2:1 is usually recommended.

2. Fat content in the diet: Impaired digestion and absorption of fat causes impaired absorption of calcium because calcium form soaps which are insoluble.

3. Phytic acid and oxalate: Oxalates in certain foods precipitate calcium in the intestine as the insoluble calcium oxalates formed insoluble salt with calcium and makes it insoluble.

4. Acidity relation: Acidic medium in intestine favour calcium absorption.

5. Protein in the diet: Calcium salts are much more soluble in amino acid than water. High protein level increases the absorption of calcium.

6. Vitamin D in the diet: Vitamin D provides acidie medium in the intestine causing more calcium absorption.

7. Parathyroid hormones: Parathyroid hormones regulate calcium level in the plasma.

8. Kidney threshold: In a normal adult any extra calcium absorded from the kidney is readily excreted in the urine.

9. Sex hormon : Low level of eestrogen hormone causes poor absorbtion of calcium.

Function of calcium: Calcium is essential for skeletal förmation, normal blood clotting, rhythmic heart action, neuromuscular excitability, enzyme activation and permeablity of membranes and acid base balance of body fluid and also curdling of milk. A number of enzymes including lipase, succinic dehydrogenase, denosinetriphophataseand certain proteolytic enzymes are activated by calcium.

Absorption of calcium : The main site of calcium absorption is the small intestine specially the proximal portion of duodenum. The percentage of absorption of calcium decrease with age, high F intakes, and high calcium intakes or low vitamin D intakes. The major route of excretion for calcium is through faeces.

Deficiency symptoms :

1. Ricket:

2.Osteomalacia. In the adult animals calcium deficiency results

in osteomalacia . In osteomalacia the bones become weak, porous and soft. Continuous mobilization of calcium from the bones for the higher demand with a low intake is responsible for this condition.

3-Osteoporosis: This is characterized by a decreased bon mass . It is due to bone resorption being greater than bone formation . It is prominent in aging and related to gonadal hormone deficiency .

4- Milk fever (parturient paresis ; calcium tetany) : Shortly after parturition, high yielding cows may suffer from milk fever . The serum calcium goes down with the result that there are muscular spasms and in extreme cases paralysis There may be breeding difficulties in pregnant animals and the calves born may be dead or very weak.

5-ln laying hens deficiency of calcium results in improper development of the eggshell which is either not fully formed or easily breakable .

The deficiency causes soft bones and beak, curved legs and low egg production.

Source of calcium: Milk and green leafy crops, especially legumes, are good sources of calcium; cereals and roots are poor sources.

Animal by product containing bone, fish meal, meat cum bone meal are rich source of calcium Dicalcium phosphate, calcium carbonate and calcium phosphate are also good source of calcium.

2.Phosphorous : Major portion of phosphorus in the animal body is distributed in the bones.

The content of inorganic phosphorus in the blood is 4 to 9 mg 100 ml depending upon the species and age. Maintenance of inorganic phosphorus level in the blood is also governed by the same factors, which promote calcium and phosphorus assimilation. Whole blood contains about 35-40 mg phosphorus per 100 ml.

Functions of Phosphorus

a)Phosphorus plays an important role in the formation of bones and teeth along with calcium. The amount of phosphorus present in these structure in about 80 percent of the total.

b) It maintained the normal level of blood calcium and its proper activity

And its proper activity.

C) It plays active role for the formation of phospholipid in the cells, nucleic acid, coenzyme, phosphoprotein and phospholipid.

d) It Plays a vital role or in energy metabolism in the formation of sugar phosphate like adenosine di phosphate (ADP) and triphosphates (ATP).

Deficiency symptoms

1. Rickets: Deficiency of phosphorus causes rickets along with calcium imbalance in young animals.

2. Osteomalacia: The element causes Osteomalacia in adult with dificinacy of calcium.

3.Pica (Depraved appetite) Phosphorus deficiency causes a specific symptom in cattle called pica. The affected animals have abnormal appetites and chew woods, bone, rags and other foreign materials The animals become very weak, if not treated, they may die due to weakness or due to secondary infections, which occur from eating decaying bones and other materials.

4. Reproduction : Low dietary intake of phosphorus has also been

associated with poor fertility, dysfunction of ovaries causing inhibition, depression and irregularity of oestrus.

Sources of Phosphorus : Animal products like fish meal , meat meal and bone meal are good sources of phosphorus . Cereal grains , wheat bran , rice bran , rice polishing , cake etc.

Are fairly good sources of phosphorus though poor source of calcium .

Leguminous fodders like berseem and lucerne are poor sources of phosphorus .

Most of the phosphorus present in the cereals and their by - products is in the from of phytates, which are the salt of phytic acid, a phosphoric acid derivative Ruminants can utilize the phytate phosphorus due to rumen microbial activity.

3. Magnesium : About 70 percent of the total magnesium is found in the skeleton the remainder being distributed in soft tissues and fluids . Blood serum contain 2 to 3 mg magnesium per100 ml. Bone contains about 1.5 percent magnesium.

Function of magnesium:

1. Magnesium plays important role in activation of

various enzymes such as phosphate transferases, decarboxylases and acyltransferases.

2. Magnesium is an activator of phosphate and takes an active part in carbohydrate metabolism.

3. It also plays an important role in calcium and phosphorous metabolism for the formation of bones and teeth.

4. Magnesium also plays an important role for the neuromuscular activity of the body.

Absorption of Magnesium: The rumen and reticulum is the major site of Mg absorption ruminants. It is also absorbed from large intestine.

Magnesium is excreted via feces, urine, and milk.

Deficiency symptoms:

1-Magnesium tetany in adult animals (grass staggers, grass tetany): also referred as lactation tetany or wheat pasture poisoning. There are other factors also which are responsible for gross staggers like hormonal disturbances and faulty interrelationship of calcium, phosphorous and magnesium. Clinical signs of tetanus include appetite, increased excitability, profuse salivation and convulsions.

2. Hypomagnesimia in young calves: This has been reported in India when calves reared on milk diet without any other supplements for prolonged period.

3. Neurological symptoms in rats: In the rats lowering of magnesium to 1.8 ppm resulted in hyper-irritability, convulsion and death. The blood picture showed normal calcium and phosphorus but magnesium content was reduced. In poultry magnesium deficiency causes neurological symptoms like rats.

Sources of Magnesium: Most of commonly fed roughage and concentrated content 0.1 percent.

Bran, oil cakes and leguminous fodder are rich source of magnesium while milk and animal products are much poorer source.

4. Sodium: It is an alkaline salt which forms about 93 percent alkali of blood serum. It is found in body fluids and muscles of the body. The total amount of sodium in the body is about 0.2 percent out of which up to 0.05 percent is deposited in bones.

Functions of sodium:

 $\checkmark$  Sodium salt is useful in the metabolism of water, protein, fat and carbohydrate.

 $\checkmark$  It controls body fluid concentration, contraction of nerve and muscle fibers, body fluid pH, osmotic pressure and help in maintaining neutrality among body tissues.

Absorption of sodium : Absorption of sodium takes place in rumen and upper small intestine . It is mainly excreted through urine with small amount is also excreted through faeces and perspiration .

Sources of sodium :

The Chief of source of sodium is sodium chloride or common salt Most of the feed and forages are poor source of sodium except the herbage which grown on alkaline soil for reclamation.

5. Potassium: Most of the Potassium is found in the cells . Excess of this salt in the body interferes with the absorption and metabolism of magnesium .

Functions of potassium :

1. Potassium is essential part along with sodium, chlorine and bicarbonate ions, in the osmotic pressure regulation of the body fluids and in the acid-base balance in the animals.

2. Potassium plays an important role in nerve and muscles excitability and activates certain enzymes.

Absorption of potassium: Potassium is absorbed mainly from the small intestine and to some extent in the large intestine. The majority of potassium excretion is in the urine and also via sweat and milk.

Deficiency symptoms:

\*potassium deficiency result in slow growth, reduced feed and water intake, lowered feed efficiency muscular weakness, nervous disorders

,emaciation, intracellular acidosis and degeneration of vital organs

\*High intake of potassium may interfere with the absorption and metabolism of magnesium in the animal, which may be an important factor in the

etiology of hypomagne- saemic tatany

Sources of potassium : outside the body potassium is available in pasture grasses. Milk also contains potassium. Inside the body it is found in muscle, plasma and body cells.

6.chlorine It is found in skin, subcutaneous tissues and gastric juices. Out of the total amount present in the body 80-85 percent chloride is found in inorganic form while the rest 15 to 20 percent in organic form.

Functions of chlorine:

1. This mineral is required for the formation of hydrochloric acid of the gastric juice

2. In the form of sodium chloride it assists in the digestion of food.

3. Chlorine is associated with sodium and potassium in acid base relationship and osmotic regulation

4. It also helps in cell nutrition, growth and reproduction among animals

Absorption of chlorine : chlorine is absorbed in combination with sodium. It is mainly absorbed from the upper small intestine. It is excreted through urine with small amount in faeces and perspiration.

deficiency symptoms:

 $\sqrt{A}$  dietary deficiency of chlorine may lead to an abnormal increase of the alkali reserve of the blood (alkalosis) caused by an excess of bicarbonate, since inadequate levels of chlorine in the body are party compensated for by increase in bicarbonate.

 $\sqrt{}$  Deficiency of salt in diet leads to decreased appetite which result in poor growth rate and milk production .

 $\sqrt{\text{Deficiency of salt in poultry leads to feather picking and canabalism}}$  .

Sources of chlorine: with the exception fish and meat meals , the chlorine content of most foods is comparatively low . The chlorine content of pasture grass varies from 3 to 25 gkg dry matter . The main source of this element for most animals is common salt .

7. Sulphur: Most of the Sulphur in the animal body occurs in proteins containing the amino acids cystine, cysteine and methionine. The two vitamins, biotin and thiamin and the hormone, insulin, also contain Sulphur.

Functions of Sulphur:-

i. Sulphur is an essential element for protein and vitamin synthesis. Wool is rich in cystine and contain about 4 percent of sulphur.

ii. It combined with iron and used for the formation of heamoglobin in red blood cells.

iii. It also useful in blood clotting and endocrine function.

iv. It also maintained intra and extra cellular fluid and acid base balance.

Absorption of sulphur: sulphur is absorbed in the rumen and small intestine. It can be recycled to the rumen with similarities to the recycling system for the

urea-nitrogen system.

Deficiency symptoms :

1 - Deficiency of sulphur in the body results in poor growth and development of the body, loss of weight, weakness Lacrimation and metabolic activites of the body are also disturbed. Microbial protein synthesis is reduced and the animal shows sign of protein malnutrition. There is evidence that sodium sulphate can be by used ruman microorganisms more efficiently than elemental

sulphur.

2- In sheep its deficiency causes production of the poor quality wool.

Sources of sulphur: All balanced rations, muscles, wings of the birds, horns, hairs, nails, bile juice, saliva, R.B.C, nervous system and hoof of the animals contain certain amount of sulphur.

TRACE ELEMENTS (MICRO ELEMENTS): Various trace minerals are discssed here. The average trace minerals content of various feeds and fodders

1. Iron: The total amount of iron found in the body is 0.004 percent. Half of this amount remains in combination with R.B.C in the form of heme associated with red colouring matter or heamoglobin. The remaining portion is found associated with myoglobin, enzyme cytochrome, peroxidase, catalase and other enzymes of the body; liver, spleen and kidney. As a respiratory enzyme it is present in all the tissues of the body.

In the form of myoglobin, iron is found in all the muscles.

Functions of Iron:

1. As a part of respiratory pigment and heamoglobin, iron helps in the utilization of oxygen by the blood.

It activates enzymes by taking part in the enzyme system and assists in proper functioning of every organ of the body. Iron is also a component of many enzymes including cytochromes and certain flavoprotiens. 4 ppm iron is necessary for the formation of blood and growth of chicks. Absorption and excretion: The amount of iron absorbed is related to its need by the animal body. The capacity of the body excrete the iron is very less therefore; its absorption is controlled by the body's requirement.

There are two hypotheses for the control of iron absorption.

 $\cdot$  Mucosal Block theory: In this case iron is absorbed by the mucosal cells of gastro-intestinal tract , when they become physiologically saturated the iron absorption is checked.

 $\cdot$  The second mechanism by which iron absorption is controlled is the passage of iron from the mucosal cells to the stream which is controlled by the oxygen tension in the blood.

Factors which affect iron absorption:

- 1. Acidic condition in the gastro-intestinal tract helps iron absorption. Absorption of iron is more efficient when body-stores are low.
- 2. Ascorbic acid in the diet also helps iron absorption.

3. High level of phosphorous and phytic acid present in the diet reduces iron absorption.

Deficiency symptoms: The deficiency symptoms iron are lower weight gain, listleness , inability to withstand circulatory strain, laboured breathing after mild exercise, reduced appetite and decreased resistance to infection. Anaemia in piglets is characterized by poor appetite and growth. Breathing becomes laboured and spasmodic and this condition is called 'thump'.

Source of Iron: Milk is poor and green forages are rich sources of iron.

2. Copper: Copper is an integral part of cytochrome A and cytochrome oxidase. It appears that copper functions in the cytochrome system in the same way as iron, that is, through a change in valency . The enzymes tyrosiniase, lactase, ascorbic acid oxidase, plasma amino oxidase, ceruloplasmin and uricase contain copper, and their activity is dependent on this element. Copper is present in blood plasma as a copper-protein complex, ceruloplasmin. Copper absorption takes place from the abomasums and small intestine. Dietary phytate, high levels of calcium carbonate, iron, zinc and molybdenum reduce absorption and excreted through faeces . Acidity of the stomach, intestinal secretion and the base content of the diet affect the absorption of copper from gastro-intestinal tract. In metabolism, copper is closely associated with molybdenum.

Excess of molybdenum in the body result in poor absorption and storage of the copper salt.

Deficiency of molybdenum causes more absorption and storage of the copper in the body.

Function of copper:

1. Copper acts as catalyst in the formation of heamoglobin and provide oxygen absorption power to red blood cells.

2. As an essential part of enzymes system copper plays important role in various metabolic Activities of the body.

3. The element is necessary for the normal pigmentation of hair, fur, wool and skin.

4. It is necessary for iron absorption from small intestine and iron absorption from tissue stores.

Deficiency symptoms: Copper deficiency includes anaemia , bone disorders neonatal ataxia, depigmentation and abnormal growth of hair and wool, impaired growth and reproductive performances, retained placenta, heart failure, gastro intestinal disturbances, immunosuppression and lesions in the brain stems and spinal cord. These lesions are associated with muscular incoordination, and occur specially in young lambs.

Enzootic ataxia: The copper deficiency condition known as enzootic ataxia has been known for some time in Australia. The disorder is these associated with pasture low in copper content (2 to 4 mg/kg DM), and can be prevented by feeding with a copper salt.

Swayback: A similar condition which occurs in lambs occurs in U.K. called swayback. The symptoms of swayback in newborn lambs range from a complete inability to stand, to various degree of in- coordination particularly of the hind limbs.

Salt sick :for many years it had been recognized in florida that cattle not thrive well due to copper deficiency. They lost their appetite. They become emaciated and weak and their blood was very low in heamoglobin . Young cattle were most affected and often badly stunted many of the animals died from the disease which is called Salt sick

Stringy wool: (Steely wool. Falling disease ;Baffing disease) :Copper plays an important role in the production of crimp in wool. The element is present in an enzyme which is responsible for the disulphide bridge in two adjacent cysteine molecules. In the absence of enzyme the protein molecules of the wool donot form this bridge and referred as Stringy or

Steely wool. This disease is called ailing or baffing disease

Falling disease :the disease is characterized by sudden death without any preliminary sign. In this fibrosis of myocardium takes place and macrocytic hypochromic type anaemia appears.

Cost disease (Nack ill,l.iskin disease) : This disease is caused by the deficiency

of copper and cobalt in diet of cattle and sheep .

3: Iondine: londine is found in thyroid gland where it is incorpotated in the

thyroxine, a hormone secretd by the gland. It is also a constituent of di-

iodotyrosine.

Functions of Iodine:

Iodine is necessary for the proper functioning of the thyroid gland, treatment of simple goitre, control of metabolic activities and for the proper growth and development.

The thyroid hormone accelerates 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.

Absorption of iodine: Iodine is absorbed from the gastrointestinal tract. The rumen is the major site of absorption whereas abomasum is the major site of the endogenous secretion or recently of circulatory iodine into the digestive tract. Iodide is excreted through urine.

Deficiency symptoms: The deficiency of iodine results in the development of simple goitre (enlargement of thyroid gland). In this condition the thyroxine production. Is reduced and so thyroid gland become over active and enlarged as a compensatory growth. The thyroid being situated in the neck, the deficiency condition in from animals manifest itself as a swelling of the neck, 'big neck'. Sources of iodine: Iodine is available in fish meal, cod liver oil and iodized salt such as sodium and potassium iodine.

4. Cobalt: Cobalt is dietary essential for ruminants because it is necessary for the

synthesis of vitamin B12 by the gastrointestinal microbes.

Functions of cobalt:

i. Cobalt is necessary for the growth and development of the body as well as for the multiplication of rumen microbes among ruminants.

ii. It forms as essential part of the enzyme system and plays an important role in the synthesis of vitamin B., in rumen. About 3 percent of ingested cobalt is converted into vitamin B12 in the rumen.

iii. Cobalt is also involved in the synthesis of DNA and the metabolism of amino acids.

iv. As a component of vitamin B12, cobalt is involved in propionate

metabolism where it acts as a cofactor.

Zinc: Zinc has been found in very tissue in the animal body. It is found in higher

concentration in skin, hair and wool than other tissue of the body. Zinc is a constituent of several enzyme systems in the body like carbonic dehydrogenase, pancreatic

carboxypeptidase, glutamic dehydrogenase and a number of pyridine nucleotide

dehydrogenases. In addition zinc act as a co-factors for many other enzymes.

Functions of Zinc :

- Zinc is an important trace element for the proper growth of body and development of hairs and keratinization of epithelial tissues .

-Being an essential part of insulin hormone it plays an important role in the metabolism of carbohydrates . It is involved in the nucleic acid and vitamin A metabolism and protein

## Synthesis.

-Zinc play a key role in both cell and antibody mediated immune responses for resistant

against infection and also provide protection against liver damage caused by toxins from the fun

Deficiency symptoms.

1-zinc deficiency in cattle: On the zinc deficient diet , milk production reduced, poor fertility , loss of hail lower feed efficiency, loss of appetite etc.

2-zinc deficiency in calves : symptoms of zinc deficiency in calves inflammation of the nose an mouth, stiffness of the joints, swollen feet and parakeratosis.

3-zinc deficiency in pigs : zinc deficiency in pigs is characterized by subnormal growth, depressed, appetite poor feed conversion efficiency and parakeratosis. the latter is a reddeing of the skin following by eruption that develop in to scab. the deficiency symptoms are more common in young one and house pigs fed ad libitum on a dry diet . High level of calcium in the calcium in the diet aggravated the condition.

4-zins deficiency in chicks : Retarded growth, 'Frizzled' feather, parakeratosis and a bone abnormalit referred to as the 'swollen hock syndrome'.

Source of zinc : Brans are rich source of zinc . Feed and fodders contain adequate amount of zinc.

6-manganese the amount of manganese present in the animal body is very small, the

highest concentration occurring in the bones, liver kidney, pancreas and pituitary gland

Excess amount of calcium and phosphorus it the body prevents it's absorption from the digestive tract.the minerals is excreted.

Functions of manganese:-

1-Manganese plays an important role for the bone devlopment and vital Eutrient in the synthesis chondroirin sultphate which the oranic. Matrix of the bone.

2-Manganese is important trace mineral for normal growth reproduction egg production and for prevention of perosis among poultry.

3-Manganese is importantin the animal body as enzyme activators such as phosphate .transferases an decarboxylases associated. With krebs cycle.

4-This trace mineral has an active role in immune functions where it helps in detoxifying free. Oxygen radicals which can cause tissue damage produced . By immune cells in response to killing bacteria.

5-Absorption of manganese. Manganese. is one of the poorly absorbed and. Retained trace minerals livestock High dietary intoke of calcium phosphorous and iron reduces manganese absorption from th small intestine the mineral is excrted out from the body along with bile in faeces and urine.

Deficiency symptoms:-

1-cattle Deficiency of manganese show poor gowth leg disorders skeletal. Abnormalities ataxia of the born and reproductive failures. 2-swine Tn swine deficiency manganese results in poor growth of bones with shortening of leg bones enlarged hocks muscular weaknese increase fat and irregular

oestrus cycle.

3-poultry Tn young chcks a. deficiency leading perosis in young birds may be aggravated by high dietar. Intakes of calcium and phosphorus Manganese deficiency in breeding reduces hatchability ancauses retraction in chicks.

3. Poultry: In young chicks a deficiency leading to perosis in young birds may be aggravated by high diet intakes of calcium and phosphorus. Manganese deficiency in breeding birds roduces hatchability an causes retraction in chicks.

Sources of manganese: Forages are rich in manganese as compared to cereals. In feed it is avnilable in maize oat, wheat, green fodder and brans.

7-Fluorine: The amount of fluorine in common feed stuffs is 1 to 2 part per million. Presence of 100 ppm fluorin in the ration on dry matter basis, and above 3 ppm in drinking water is toxic to animals.

Functions of Fluorine: In very small amount the mineral is essential for the growth proper development the bones and teeth. It reduces the incidence of dental caries.

Deficiency symptoms: Deficiency of fluorine causes dental caries. Toxicity of fluorine: The

major clinical signs of fluorine toxicity are found in teeth and bone. It is slowly ben deposited in the body and produces ill effect afterward. The bone become thick and soft with dirty colouratio: teeth loss their normal shining appearance. Finally they become soft and very weak. They look quite bad and ar unable to bear cold water. Sometime yellow and black spots are also visible on the teeth. It results in loss appetite. Growth and production.

8- Selenium : The presence of selenium in roughages ind concentrates is harmful to the animals. In soils it may be present upto 40 ppm .

Selenium is present all cells of the body but concentration is normally less than 1 ppn. Toxic concentration in liver and kidney are normally between 5 and 10 ppm. Most important role of selenium in livestock is prevention of liver necrosis in rat and exudative diathesis in chicks.

Functions of Selenium :

1. Selenium is essential for growth, reproduction, prevention of various diseases and protection of the integrity of tissues. The metabolic function of selenium is closely related with vitamin E and acts as a antioxidant and required foI adequate immune response.

2. It is essential for prostaglandin synthesis and essential fatty acid metabolism.

3. It has a strong tendency to complex with heavy metals and exerts a protective effect against the heavy metals.

4. Selenium is important part of an enzyme glutathione peroxidase.

This enzyme destroys peroxides before they can damage body tissues.

5. Selenium is also important in sulphur amino acid synthesis, Sulphur amino acids protect animals against several diseases associated with low intakes of selenium and vitamin E. This protection is due to the antioxidant activity of selenium.

Deficiency symptoms:

1. Deficiency of selenium in the diet causes myopathies in sheep and cattle.

2. In hens selenium deficiency reduces hatchability and egg production. Exudative

diathesis, a haemorrhagi Disease of chick and dietary liver necrosis in pigs are prevented by either selenium or vitamin E.

3. Bilateral paleness and dystrophy of the skeletal muscle, mottling and dystrophy of

myocardiurn (mulberr Heart disease) are noticed in pigs. Mulberry heart disease is most common when cereal based diet contain Less than 0.05 ppm selenium.

Toxic effect: Selenium toxicity is known as 'alkali disease' and 'blind staggers'. Which is

characterized to Stiffness of joints, lameness, loss of hair from mane and tail and skin lesions on the legs/ In some type parts of Haryan And Punjab, the animals suffer with selenosis, the disease is known as Degnala.

9. Molybdenum: This mineral is available in pasture grasses, liver, intestinalüssvi s and milk of the animals.

Functions of Molybdenum:

1. As a component of the enzyme xanthineoxidase, especially important to

poultry for uric acid formation.

2. As a constituent of nitrate reductase it also helps in the utilization of nitrate.

3. It also takes parts in purine metabolism and stimulates action of rumen microorganism.

4. Molybdenum participates in the reaction of the enzyme with cytochrome C and

also facilitates the reduction of cytochrome C by aldehyde oxidase.

Absorption of molybdenum: Molybdenum is absorbed from the intestine. It is

excreted through urine with small amount in bile and milk.

Deficiency symptoms: Deficiency symptoms under natural condition have not been reported.

toxic effect: In the molybdenum toxicity (molybdenosis) in ruminants suffer from extreme diarrhea, loss in weight and reduced milk yields. The condition is known as teartness.

10.chromium: chromium has been found in nuccleoproteins isolated from beef liver and also on RNA preparation. It may play a rolein the maintenance of the configuration of the RNA molecule. Chromium has also peen shown to catalyze the phospho- glucomutase system activates the succinic dehydrogenase-cytochrom system. Chromium influences metabolism of glucose, lipid and protein.

Chromium is a primary active componer of glucose tolerance factor (GTF) which makes the metabolic action of hormone insulin, more effective is egulating energy utilization, muscle tissue deposition, fat metabolism and serum cholesterol levels. As an integrara part of GTF, it helps in blinding insulin to cell membrane receptors sites and subsequent transport of glucose and amino acids inside the cells.

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