

**BIHAR ANIMAL SCIENCES UNIVERSITY**

**Bihar Veterinary College, Patna**

**Department of Animal Nutrition**

**Course No. ANN-602 (T)**

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**General Role of Minerals**

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# Course Outline

ANN 602

ANIMAL NUTRITION – MINERALS, VITAMINS AND  
FEED ADDITIVES

3+1

## Objective

Role, requirement, functions, deficiency and toxic effects of vitamins, essential, probably essential and toxic minerals. Understanding soil-plant-animal-human relationship for utilization of minerals. Recent trends in the use of feed additives, probiotics, prebiotic and enzymes in animal feeding.

## Theory

### UNIT I

Essential minerals, general role of minerals, soil-plant-animal-human relationship, requirement of minerals, factors affecting requirements. Macro elements and micro elements, their distribution, metabolism, physiological functions, deficiencies and excesses, requirements and sources. Probable essential minerals. Toxic minerals.

Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat-soluble vitamins.

### UNIT II

Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbage. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals.

### UNIT III

Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants. Feed additives including probiotics, Prebiotics, Symbiotics and feed enzymes. Research techniques in nutrition.

## Practical

General principles of mineral estimation, Sampling and processing techniques. Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies. Principles of vitamin estimation. Estimation of some important vitamins (vitamin A, E, C). Formulation of vitamin mixture for various species.

## Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.  
Krislina G & Ranjhan SK. 1991. *Special Analytical Techniques*. Kalyani.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.  
McDowell LR. 2003. *Minerals in Animal and Human Nutrition*. Reed Elsevier India.  
Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

- Inorganic component of diet
- Represented by total ash
- Perform essential functions & must be present in food
- In animal tissues and feeds, minerals are present in varying amounts and concentrations.
- Total body mineral → **Ca (46%)**
  - **P (29%)**
  - **Mg, Na, K, Cl, S (25%)**
  - **micro minerals (3%)**

- Essential Minerals:
  - Major/macro- 07
  - Minor/Micro-05
- **Major/macro:**
  - The **seven minerals** that are present in high concentration (>70 mg/kg live weight) are termed as major minerals.
  - Calcium (Ca), Phosphorus (P), Magnesium (Mg), Sodium (Na), Potassium (K), Chlorine (Cl), Sulphur (S)

# Minerals

- **Trace elements or Micro minerals** are those minerals that are present in **low concentration** (<70 mg/kg live weight)
- but are physiologically equally important.
- The following fifteen trace elements are essential to fulfil physiological functions in the body

Iron (Fe)	<u>Chromium</u> (Cr)
Copper (Cu)	<u>Fluorine</u> (F)
Cobalt (Co)	Tin (Su)
Manganese (Mg)	Vanadium (V)
Zinc (Zn)	Silicon (Si)
Iodine (I)	Nickel (Ni)
Selenium (Se)	<u>Arsenic</u> (As)
Molybdenum (Mo)	

# Minerals: General functions

**I. Structural:** *form structural* components of body organs and tissues,

eg. as calcium, phosphorus and magnesium in **bones and teeth**; and phosphorus and sulfur in **muscle proteins**.

**II. Physiological:** *in body fluids* and tissues as electrolytes concerned with the maintenance of **osmotic pressure, acid–base balance, membrane permeability and transmission of nerve impulses**.

eg. sodium, potassium, chlorine, calcium and magnesium in the blood, cerebrospinal fluid and gastric juice

**III. Catalytic:** act as catalysts in **enzyme and endocrine systems**, as integral and specific components of the structure of **metallo enzymes and hormones** or as activators (coenzymes) within those systems.

# Minerals

**Table 1.1.** Some important metalloenzymes and metalloproteins in livestock.

Metal	Metalloenzyme or metalloprotein	Function
Fe	Hepcidin	Iron regulating hormone
	Succinate dehydrogenase	Oxidation of carbohydrates
	Haemoglobin	Oxygen transport in blood
Cu	Catalase	Protection against hydrogen peroxide, $H_2O_2$
	Cytochrome oxidase	Terminal oxidase
	Lysyl oxidase	Lysine oxidation
	Hephaestin	Iron absorption
Mn	Caeruloplasmin	Copper transport
	Superoxide dismutase	Dismutation of superoxide radical, $O_2^-$
	Pyruvate carboxylase	Pyruvate metabolism
Se	Superoxide dismutase	Antioxidant by removing $O_2^-$
	Glycosyl aminotransferases	Proteoglycan synthesis
	Glutathione peroxidases (four)	Removal of $H_2O_2$ and hydroperoxides
	Type 1 and 2 deiodinases	Conversion of tetraiodothyronine to triiodothyronine
Zn	Selenocysteine	Selenium transport and synthesis of selenoenzymes
	Carbonic anhydrase	Formation of carbon dioxide
	Alkaline phosphatase	Hydrolysis of phosphate esters
	Phospholipase $A_2$	Hydrolysis of phosphatidylcholine

# Minerals: General functions

- **Regulatory:** *minerals regulate cell replication and differentiation;*
  - eg. calcium ions influence signal transduction and selenocysteine influences gene transcription, The pivotal metabolic role of thyroxine has been attributed to the influence of triiodothyronine on gene transcription
- **Component of biomolecules:** of biologically important compounds
  - Iron in haemoglobin
  - Cobalt in vitamin B<sub>12</sub>
  - Iodine in the hormone thyroxine

**Thank you**