BIHAR ANIMAL SCIENCES UNIVERSITY

Bihar Veterinary College, Patna

Department of Animal Nutrition

Unit- I, Lecture- 9

Magnesium, Sodium, Potassium,Chlorine and Sulphur in Animal Health and Production

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Essential Minerals

- **Essential Minerals:**
  - Major/Macro- 07
  - Minor/Micro-15
- **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)

Magnesium

- **70 % of the total Mg in the skeleton, rest in soft tissues and fluids.**
- Normal serum Mg in cattle is 1.7- 4 mg per 100 ml.

Functions of Mg:

- Component of bone (36% Ca, 17% P, 0.5% Mg).
- ***Activator of enzymes***
  - Pyruvate carboxylase, pyruvate oxidase and creatine kinase.
- **Controls the irritability of neuromuscular system.**

Deficiency disease of Mg:

- **Hypomagnesaemic tetany/ grass tetany/ grass staggers/ lactation tetany**:
  - Low blood Mg levels (below 0.5 mg per 100ml)
  - **Lusch & succulent Pasture (spring) – low in Mg**
  - Nervousness, tremors, twitching of the facial muscles,
  - Staggering gait, convulsion.
  - ***Treatment***: 50 gm MgO orally/ Mineral Mixture.

Sources: Wheat bran, dried yeast and most vegetable protein sources, green plants

Sulphur

Sulphur is constituents of:

- **Amino acids:**
  - **Cystine, Cystiene , Methionine, Taurine**
- **Vitamins:**
  - **Thiamin and Biotin**
- **Constituents of hormone**
  - Insulin
- **Chondroitin sulphate (component of cartilage)**
- **Heparin,**
- **Glutathione,**
- **Conenzyme-A**
  - Wool is rich in cystine
    - **4 % sulphur.**

Sulphur

Deficiency:

- Deficiency of sulphur would indicate a protein deficiency.
  - S containing amino acids
- Affects NPN or urea utilization:
- S is required for the synthesis of cystine, cystiene and methionine in the rumen.
  - **N: S::10:1**

Toxicity:

- Excess dietary S converted by rumen microbes to hydrogen sulphide (a toxic agent).
  - Reduces rumen motility and causes nervous and respiratory distress.

Sodium, Potassium and Chlorine

- **Na^++ K^+- Cl^- is termed as ‘dietary electrolyte balance’.**
- **Maintains Acid-Base balance**
- **Osmotic pressure,**
- **Water metabolism.**

Sodium

- **Chief cation** of blood plasma and **extra cellular fluids**.
- Maintains **osmotic pressure and acid-base balance**.
- Transmission of nerve impulses
- Sodium metabolism is regulated by the hormone **aldosternone**.
- **Deficiency symptoms:**

  Depressed growth

  Lowered egg production in laying hens

  Lowering of the osmotic pressure~ Dehydration of the body.
- **Sources:**
  - Sodium chloride or common salt.
  - Sodium content is high in animal products (Meat meals, Marine origin)
  - Feeds of vegetable origin have low sodium content.

Potassium

Functions:

- **Chief cation of the intra-cellular fluid**.
- Maintains osmotic pressure and acid-base balance
- **Nerve and muscle excitability**, and carbohydrate metabolism.

Deficiency symptoms:

- ***Ruminants*: N**ormally doesnot occur in farm animals
  - the green fodder are rich sources of this element.
- ***Poultry*** :
  - Decreased growth rate,
  - Weakness
  - Tetany and Death.

Sources:

- Potassium content is generally very high in plants.

Chlorine

Functions:

- Maintains osmotic pressure and acid-base balance

  in association with Na & K.

- Constituents of **hydrochloric acid** in the gastric secretion
  - Pepsinogen to Pepsin
  - Normal Na: K ratio in saliva is 20:1.

Deficiency symptoms:

- *Alkalosis*
  - Deficiency of chlorine lead to an abnormal increase of the alkali reserve (especially bicarbonate) of the blood).

Sources:

- Fish and meat meal is a rich source of chlorine.
- Sodium chloride or common
- All other foods are low in chlorine.

Common salt

- Serves as a condiment as well as a nutrient.
- Stimulates salivary secretions
- Plants are low in sodium and chlorine,
  - Usual practice to give common salt (NaCl) to herbivores.

Deficiency:

  - Decreased appetite
  - Lowered growth rate/Lowered milk production.
  - Feather pickling and **cannibalism** in Poultry.

Excess of salt intake

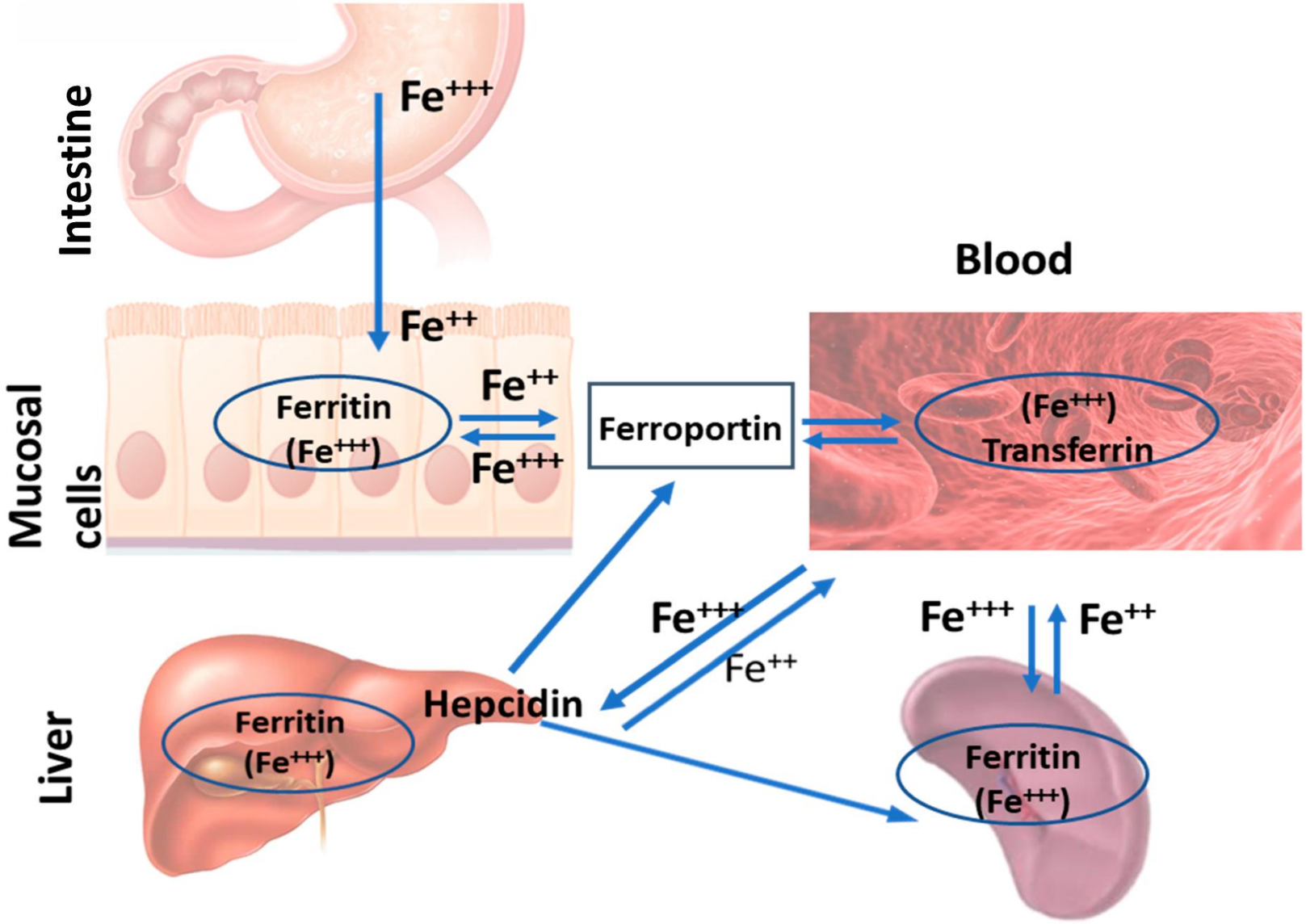
- Excessive thirst,
- Oedema.
- Salt poisoning in pigs and poultry, especially when fresh drinking water is limited.

IRON

- 65% of body iron is in the form of Haemoglobin (Hb)
  - (Hb contains about 0.34 percent of iron).
- 30% of the Fe is in **ferritin and haemosiderin**, 3% is in myoglobin.

- **FUNCTIONS:**
- Iron as a constituent of haemoglobin,
- Helps in transport of oxygen to the tissues.
- Maintenance of oxidative enzyme system
- Many enzymes are activated by iron
  - *Cytochrome oxidases*
  - *Catalase*,
  - *Peroxidaes*,

IRON


Intestine
Fe+++
Fe++
Mucosal cells
Ferritin (Fe+++)
Fe++
Fe+++
Ferroportin
Blood
(Fe+++) Transferrin
Fe+++
Fe++
Fe+++
Fe++
Liver
Ferritin (Fe+++)
Hepcidin
Ferritin (Fe+++)

IRON

Metabolism:

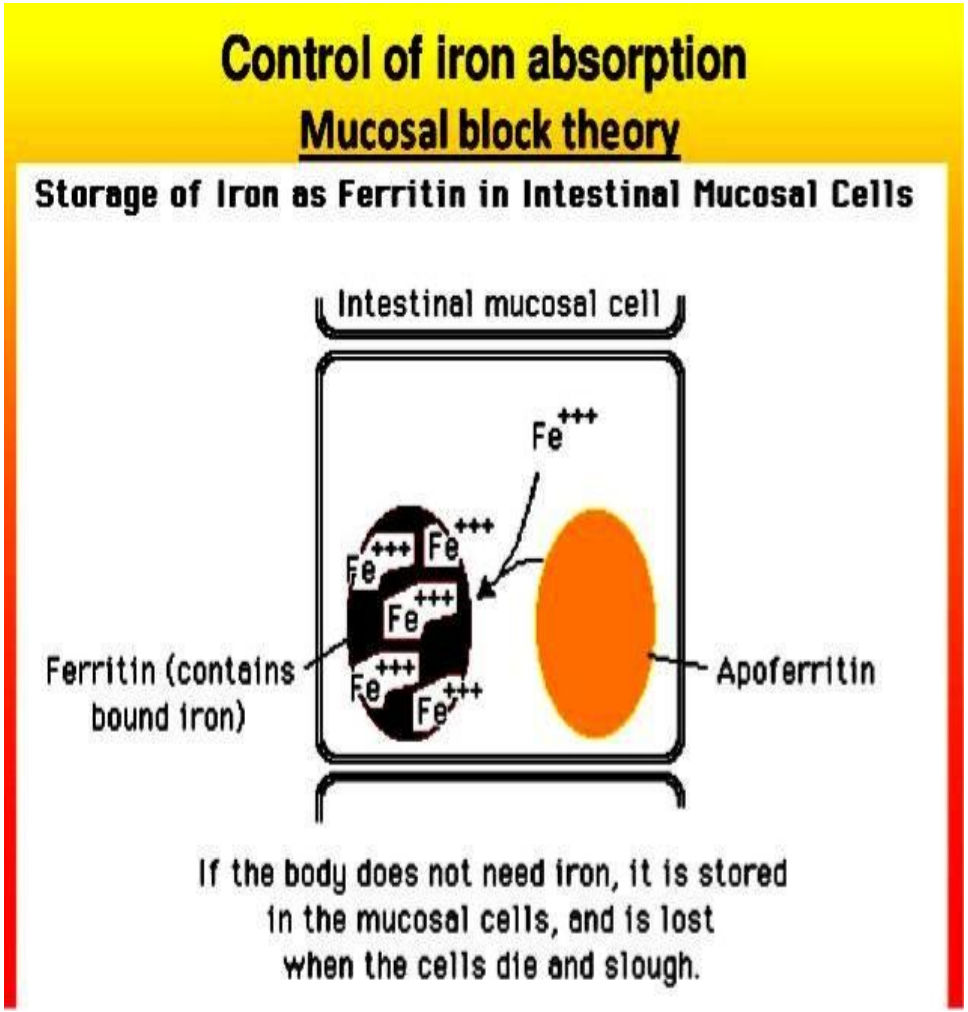
- Iron is present in feed as in ferric iron (Fe^{3+}).
- Reduced in the acid medium of the stomach to ferrous from (Fe^{2+}), the form necessary for absorption.
- Absorbed in the upper small intestine (Duodenum & Jejunum).
- In mucosal cells of the intestine, iron combines with a protein, **apoferritin**, to form **ferritin** (contains 20% iron by weight).
- Mucosal ferritin delivers ferrous iron to the portal blood circulation, where the iron again is converted back to the ferric state by oxidation. As ferric iron it combines with a plasma globulin (carrier protein) to form a ferric-protein complex known as **Transferrin.**
- **Transferrin** delivers iron to the bone marrow for haemoglobin synthesis and to all other cells for the synthesis of iron containing enzymes.
- When the total quantity of iron in the body is more then the appoferritin storage pool can accommodate, some of it is stored in an extremely insoluble form called **haemosiderin** (contains 40% iron by weight).

IRON

Mucosal Block Theory

‘Mucosal Block Theory’:

Mucosal cells of the gastro-intestinal tract absorb iron and convert it into ‘ferritin’, and when the cells become physiologically saturated with ferritin, further absorption is blocked until the iron is released and transferred to plasma.



IRON

Deficiency:

- Deficiency due to inadequate intake
  - High cereal diet, low in animal food
  - Inadequate absorption (e.g gastrointestinal disturbances like diarrohea or intestinal disease)
  - Excessive loss of blood.
- **Anaemia** due to lower haemoglobin synthesis.
- **Piglet anemia or thumps:**
  - Iron deficiency in piglets
  - poor growth, poor appetite, laboured and spasmodic breathing.

Prevention

  - I/M Inj. 200 mg of iron dextran at the age of 3 days.
  - Application of Iron on Sow`s teat
  - Access of soil by Sow