



ANN- unit 3

UPSC CSE VET SCI OPTIONAL

▶ **UPSC PYQs**

1. Why is Vitamin A important for the animal body? What are the deficiency symptoms of Vitamin A in animals? (2014)
2. Enumerate the water soluble vitamins. Write the coenzymes or prosthetic groups and enzymic or other functions of B vitamins. Write the functions and deficiency symptoms of Vitamin E in poultry? (2015)
3. Write in brief about mucosal block theory of iron absorption? (2017)
4. Write in brief about the role of Vitamin A in vision? (2017)
5. Differentiate between curled toe paralysis and polyneuritis? (2017)
6. What are the common sources of calcium and phosphorus? How high intake of calcium affects the utilization of other minerals? Explain how nutritional secondary hyperparathyroidism develops in animals? (2017)
7. Write in brief about nutrient parasite interrelationship ? (2018)
8. Write in brief about the role of Vitamin D in calcium absorption? (2018)
9. Write the Chemical nature, physiological functions and deficiency symptoms of Vitamin A in animals? (2018)
10. Mention different metalloenzymes and their functions in livestock? (2018)
11. Classify the minerals and explain the role of calcium, phosphorus and vitamin D in bone formation? (2019)
12. Classify vitamins. What do you mean by essential and non- essential vitamins? Mention the coenzymes and enzyme prosthetic groups of B vitamins along with their function in metabolism? (2020)
13. Describe the mineral deficiency disorders of animals? (2022)
14. Mention the general functions of minerals in animals. Justify the importance of Vitamin D in optimum calcium and phosphorus nutrition in animals? (2023).

► **Classification of Minerals:** Two type

► **Major (Macro) Minerals**

- Calcium (Ca)
- Phosphorus (P)
- Sodium (Na)
- Chlorine (Cl)
- Potassium (K)
- Magnesium (Mg)
- Sulfur (S)

• **Minor (Trace) Minerals**

- Zinc (Zn)
- Copper (Cu)
- Cobalt (Co)
- Iron (Fe)
- Iodine (I)
- Manganese (Mn)
- Selenium (Se)
- Molybdenum (Mo)

Functions of Minerals

1. Structural Functions

- Calcium and Phosphorus: Essential for bone and teeth formation and maintenance.

2. Catalytic Functions

3. Electrolyte Balance

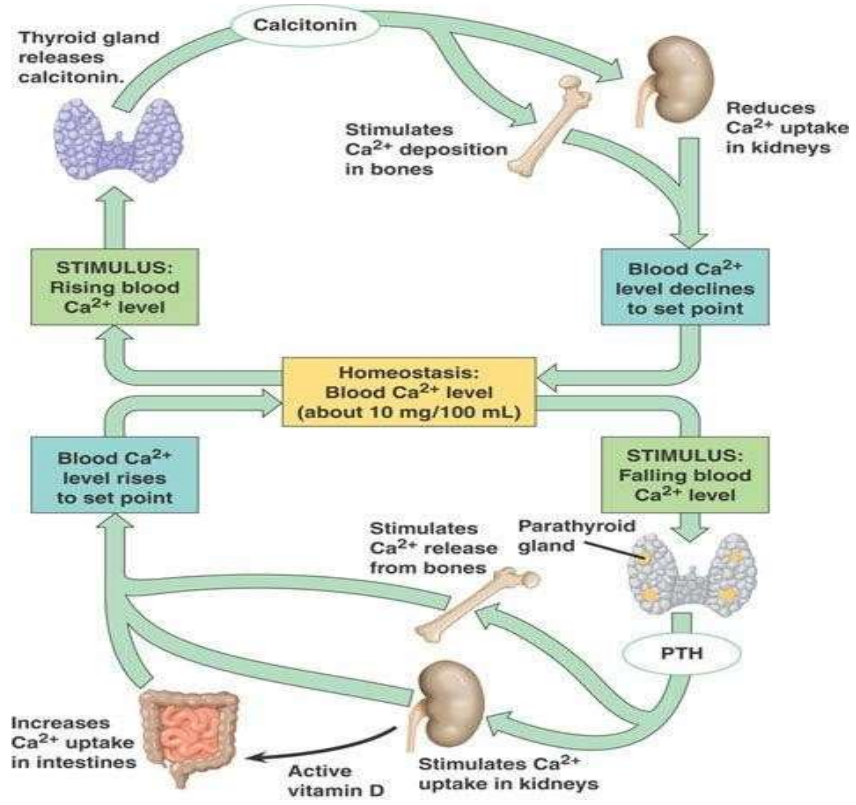
- Sodium, Potassium, and Chlorine: Maintain acid-base balance and osmotic pressure in body fluids.

Nutrient-Parasite Interrelationship

1. Parasites affect the host's nutrient utilization and cause metabolic disturbances.
2. Improved host nutrition leads to better resilience against parasites.
3. The host prioritizes growth, pregnancy, and lactation over immunity, which can affect the degree of immunity expressed during these phases.
4. Parasites compete with the host for nutrients and can cause disease, shaping host populations.
5. Protein supplementation can alleviate the effects of parasitism, increase immunity, and resistance to reinfection.
6. Macro-minerals and trace elements also influence the host-parasite relationship.
7. Genetic resistance to parasites does not always correlate with productivity within a breed, but superior genotypes maintain their advantage even on a low-protein diet.

Calcium (Ca)

- ▶ 99% of the calcium is found in bones and teeth
- ▶ 1% is involved in vital metabolic functions
- ▶ Functions:
 - ▶ 1. Blood Coagulation
 - ▶ 2. Nerve Impulse Transmission
 - ▶ 3. Muscle Contraction
- ▶ **Deficiency Symptoms**
 - ▶ **1. Young Animals:**
 - ▶ Rickets-weak and deformed bones due to inadequate mineralization.
 - ▶ **2. Adult Animals:**
 - ▶ Osteomalacia-Softening of the bones caused by defective bone mineralization.
 - ▶ Milk Fever (Parturient Paresis)



High Ca intake Effects:

- **Phosphorus:** Excess calcium can reduce phosphorus absorption.
- **Magnesium:** High calcium may impair magnesium absorption.
- **Zinc:** Excess calcium can inhibit zinc absorption.
- **Iron:** High calcium levels can interfere with iron absorption.

Phosphorus (P)

▶ Deficiency Symptoms

1. Pica (Depraved Appetite/Allotriophagy):

- ▶ Abnormal cravings and eating non-food items such as wood, soil, and bones.

2. Post-Parturient Hemoglobinuria (PPH):

- ▶ A condition in cows characterized by the breakdown of red blood cells after calving, leading to hemoglobinuria (presence of hemoglobin in urine).

- ### 3. Ca : P Ratio
- The optimal calcium to phosphorus ratio is 2:1. An imbalance can lead to conditions such as "**Big Head Disease**" in horses, where excessive phosphorus intake relative to calcium causes bone deformities.

common sources of calcium Ca & P include:

- **Bone Meal:** This is a rich source of both calcium and phosphorus, commonly used in animal feed.
- **Fish Meal:** Provides a good balance of calcium and phosphorus, often used in aquaculture and livestock feed.
- **Alfalfa:** High in calcium and also contains phosphorus, used as feed for various animals.
- **Dicalcium Phosphate:** A supplement added to animal feed to ensure adequate calcium and phosphorus levels.
- **Calcium Carbonate:** Often added to animal feed to provide additional calcium.
- **Forage and Grass:** Rich in calcium and phosphorus, especially important for grazing animals.

Potassium (K)

- ▶ Chief Intracellular Cation
- ▶ Nerve and Muscle Activity: Essential for normal nerve impulse transmission and muscle contraction.
- ▶ Enzyme Activation: Activates various enzymes involved in carbohydrate and protein metabolism.
- ▶ **Sources:**
- ▶ Natural Conditions: Grass and green fodder are rich sources of potassium.
- ▶ **Deficiency Symptoms**
- ▶ Synthetic Milk: Potassium deficiency can occur in animals fed synthetic milk, leading to reduced nerve and muscle activity, and in severe cases, paralysis.

Sodium (Na)

- ▶ **Chief Extracellular Cation:** Sodium is the primary cation outside cells, crucial for maintaining fluid balance and nerve function.
- ▶ **Functions:**
 - ▶ Water Intake Increases water intake, which is particularly important during heat stress.
 - ▶ Acid-Base Balance: Helps maintain acid-base balance in the body.
- ▶ **Sources:**
 - ▶ Common Salt (NaCl): The primary source of sodium in animal diets.
- ▶ **Deficiency Symptoms**
 - General: Slow growth, keratinization of corneal epithelium, impotency in males, delayed sexual maturity, and impaired estrus.
 - Poultry: Feather picking and cannibalism.
 - Salt Poisoning: Common in pigs and poultry when excessive salt is consumed.

Chlorine (Cl)

- ▶ Importance and Functions

- ▶ **Functions:**

- ▶ Acid-Base Balance: Helps maintain the acid-base balance in body fluids.
- ▶ Electrolyte Balance: Works with sodium to regulate osmotic pressure and fluid balance.

- ▶ **Sources**

- ▶ Common Salt (NaCl): The primary source of chlorine in animal diets.

- ▶ **Deficiency Symptoms**

- General: Deficiency of chlorine can lead to an abnormal increase in the alkali reserve, resulting in alkalosis.
- Poultry: Deficiency can lead to feather picking and cannibalism.

Sulfur (S)

- ▶ Importance and Functions
 - Amino Acids: Integral component of sulfur-containing amino acids such as cystine, cysteine, and methionine.
 - Vitamins: Essential for the synthesis of vitamins like biotin and thiamin.
 - Hormones: Part of important hormones like insulin and oxytocin.
 - Wool: Rich in cysteine, wool contains about 4% sulfur. The nitrogen to sulfur (N:S) ratio in wool is typically 5:1.
 - NPN Supplementation: For non-protein nitrogen supplementation in ruminants, the N:S ratio should be 10:1 (or up to 15:1).

Magnesium (Mg)

► Importance and Functions

- Enzyme Activation: Acts as a cofactor for enzymes such as pyruvate carboxylase and pyruvate oxidase.

► Deficiency Symptoms

- Hypomagnesemic Tetany: Also known as grass tetany or lactation tetany, characterized by muscle spasms, convulsions, and potentially death due to respiratory failure.
- Lactation Tetany: Occurs in lactating animals.
- Grass Staggers: A condition in grazing animals, particularly ruminants, due to low magnesium levels in lush, fast-growing pastures.

Iron (Fe)

► Importance and Functions

- Transport: Iron is transported in the body by transferrin.
- Storage: Stored in the form of ferritin and hemosiderin.

► **Deficiency Symptoms**

- Piglet Anemia: Known as "thumps," characterized by labored breathing due to iron deficiency in young pigs.
- Iron Absorption: Governed by the mucosal block theory, where ferritin saturation in the intestinal mucosa regulates iron absorption.

Mucosal block theory of iron absorption:

- Hepcidin Binding
- Ferroportin Interaction
- Internalization
- Degradation

Copper (Cu)

Functions:

- Essential for normal pigmentation of hair, fur, and wool
- Component of **turacin**, a pigment found in feathers
- ▶ **Deficiency Symptoms:**
 1. Lambs: Muscular incoordination leading to sway back condition (**enzootic ataxia**)
 2. Wool: Loss of crimp, resulting in stringy or steely wool due to disruption of disulfide linkages between cysteine molecules
 3. **Falling disease:** Degeneration of heart muscle (myocardium)
 4. **Microcytic anemia in pigs, poultry, and calves**

Cobalt (Co)

► Functions:

- Essential component of cyanocobalamin (vitamin B12)

► Deficiency:

- "Pining" condition in ruminants, characterized by : Loss of appetite

Iodine (I)

► Functions:

- Essential component of thyroid hormones (thyroxine and triiodothyronine)

► Deficiency:

- Goiter (enlarged thyroid gland)

► Note on Goitrogenic Compounds:

- Found in Brassica genus plants (e.g., cabbage)
- Inhibit iodination of tyrosine, interfering with thyroid hormone synthesis

Manganese (Mn)

► Functions:

- Activates glycosyl transferases, important for bone formation

► Deficiency Symptoms:

Poultry:

- Perosis (slipped tendon) - malformation of leg bones Reduced hatchability and eggshell thickness
- Head retraction in chicks

Zinc (Zn)

▶ Functions:

- Component of numerous enzymes: Carbonic anhydrase

▶ Deficiency Symptoms:

1. Skin disorders:

- ▶ Parakeratosis in pigs (thickening and hardening of skin) Bone abnormalities: 'Swollen hock syndrome' in poultry

2. Bone abnormalities: 'Swollen hock syndrome' in poultry

Molybdenum (Mo)

- ▶ Known for its interaction with copper (Cu)
- ▶ Acts as an antagonist to Cu, Zn, and sulfur (S)
- ▶ Toxicity/Deficiency:
 - Teartness or peat scour: Can be caused by either Mo toxicity or acute Cu deficiency

Selenium (Se)

- ▶ Considered one of the most toxic minerals when in excess
- ▶ Functions:
 - Component of glutathione peroxidase enzyme
 - Works synergistically with Vitamin E as an antioxidant
- ▶ Toxicity Symptoms:
 1. Alkali disease
 2. Blind staggers
 3. Degnala disease
 4. Hoof deformity

Fluorine (F)

- ▶ Bureau of Indian Standards (BIS) recommends that F concentration in mineral mixtures should not exceed 0.06%.
- ▶ Functions : Prevention of dental caries

Chromium (Cr)

► Functions:

1. Acts as a glucose tolerance factor
2. Functions similar to insulin-like growth factor (IGF-1)
3. Carcass modifying effects : Enhances nitrogen (N) retention
4. Helps reduce stress and metabolic disorders

Nickel (Ni)

- ▶ Function:
- Important for urease activity in the rumen

Metalloenzymes:

Metalloenzymes are a class of enzymes that require metal ions as cofactors for their catalytic activity. In livestock, various metalloenzymes play crucial roles in a range of physiological processes. Here are some examples of metalloenzymes and their functions in livestock:

► **Function:**

Cytochrome P450 Enzymes(Fe): These heme-containing enzymes are involved in drug metabolism and the detoxification of xenobiotics in the liver. They also play a role in steroid hormone metabolism.

Superoxide Dismutase (SOD) (Cu,Zn,Mn): SOD contains metal ions like copper, zinc, or manganese and is essential for the antioxidant defense system. It helps protect cells from oxidative damage by converting superoxide radicals into oxygen and hydrogen peroxide.

Catalase(Fe): Catalase is another antioxidant enzyme containing iron heme. It catalyzes the breakdown of hydrogen peroxide into water and oxygen, protecting cells from oxidative stress.

Carbonic Anhydrase(Zn): Carbonic anhydrase contains zinc ions and is involved in the regulation of acid-base balance and the transport of carbon dioxide in blood and tissues.

Mineral Interactions in Farm Animals

▶ **Synergistic Interactions:**

- **Gastrointestinal Tract:** Certain mineral pairs, such as calcium (Ca) and phosphorus (P) or sodium (Na) and chlorine (Cl), can enhance each other's absorption when provided at proper ratios.

▶ **Antagonistic Interactions:**

- ▶ One-Sided Antagonism: Examples include the inhibition of absorption between phosphorus (P) and magnesium (Mg) or between zinc (Zn) and copper (Cu) in the intestine.

▶ **Mechanisms of Antagonism:**

- **Complex formation:** Excess Mg in the diet may form complex magnesium phosphate, affecting the absorption of both elements.

Vitamin D, Calcium and Phosphorus

Selenium and Vitamin E:

- ▶ Selenium enhances the effectiveness of vitamin E by facilitating its regeneration after it has neutralized free radicals. This interaction ensures that vitamin E remains available to continue protecting cells from oxidative damage, thereby supporting immune health

Copper and Molybdenum:

- ▶ Excessive molybdenum (Mo) intake can interfere with copper (Cu) absorption and utilization. This interaction can lead to copper deficiency in animals, especially sheep, resulting in health issues.

How Nutritional Secondary Hyperparathyroidism (NSH) develops in animals

1. **Inadequate Dietary Calcium:** NSH begins with a diet lacking sufficient calcium.
2. **Calcium Absorption Efforts:** The animal's body tries to absorb more calcium from the gut, primarily the small intestine.
3. **Parathyroid Gland Response:** Parathyroid glands detect low blood calcium levels. They respond by secreting increased parathyroid hormone (PTH).
4. **Phosphorus Imbalance:** PTH also decreases blood phosphorus levels by reducing kidney reabsorption.
5. **Bone Health Impact:** Continuous calcium release from bones and phosphorus imbalance weaken bones.

Vitamin sources and deficiency symptoms

- ▶ Vitamins are classified based on their solubility into fat-soluble and water-soluble vitamins.

- ▶ Fat-Soluble Vitamins
 1. **Vitamin A**
 2. **Vitamin D**
 3. **Vitamin E**
 4. **Vitamin K**

Water-Soluble Vitamins

Vitamin B Complex

1. **Thiamin (Vitamin B1)**
2. **Riboflavin (Vitamin B2)**
3. **Niacin (Vitamin B3)**
4. **Choline (Vitamin B4)**
5. **Pantothenic Acid (Vitamin B5)**
6. **Pyridoxin (Vitamin B6)**
7. **Biotin (Vitamin B7)**
8. **Inositol (Vitamin B8)**
9. **Folate/Folic acid (Vitamin B9)**
10. **P-Amino Benzoic Acid (Vitamin B10)**
11. **Salicyclic acid (Vitamin B11)**
12. **Cyanocobalamin (Vitamin B12)**

i.

j.

2. Vitamin C (Ascorbic Acid)

Official Recognize now !

1. Vitamin B1 (thiamine)
2. Vitamin B2 (riboflavin)
3. Vitamin B3 (niacin)
4. Vitamin B5 (pantothenic acid)
5. Vitamin B6 (pyridoxine)
6. Vitamin B7 (biotin)
7. Vitamin B9 (folic acid)
8. Vitamin B12 (cobalamin)

No need to remember **4,8,10,11**

- ▶ **Essential vitamins:** Vitamins that are required for normal bodily functions and must be obtained through diet because the body cannot synthesize them in sufficient quantities. These Must be obtained from food sources such as fruits, vegetables, grains, dairy, and meats. E.g. Vitamin A, C, E, B complex
- ▶ **Nonessential vitamins:** Vitamins that the body can synthesize on its own and do not need to be obtained directly from the diet. These can be produced by the body, although dietary sources can still contribute to overall intake. E.g. vitamin D, K

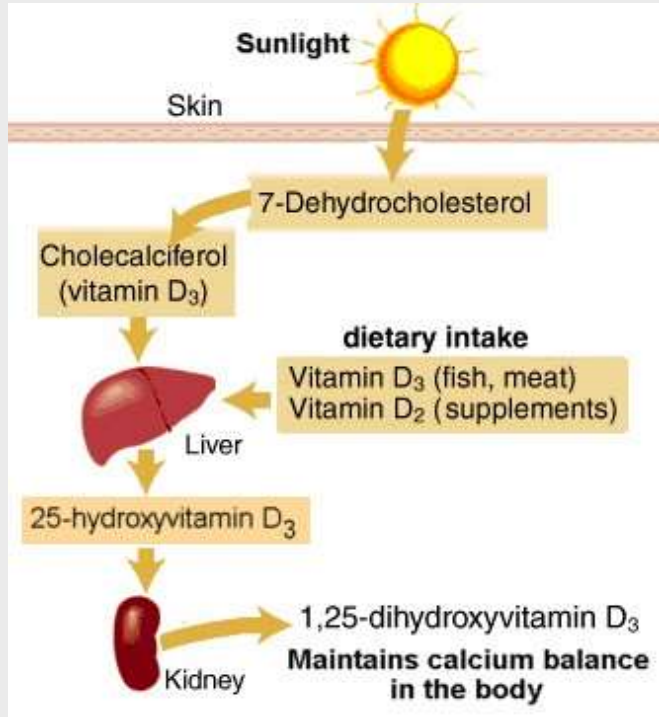
VITAMIN- A (RETINOL)

► Functions

1. Vision: Essential for the synthesis of rhodopsin, a pigment in the retina that is necessary for night vision.

► Deficiency Symptoms

1. **Night Blindness:** Impaired synthesis of rhodopsin leads to difficulty seeing in low light conditions.
2. **Xerophthalmia:** Dryness of the conjunctiva and cornea, which can lead to blindness.
3. Infertility: Reproductive issues due to impaired development and function of reproductive organs.
4. **Nutritional Roup in Poultry:** Respiratory infection characterized by nasal discharge, swollen eyes, and reduced egg production.
5. **Bitot's Spots:** Foamy patches on the conjunctiva, indicative of severe vitamin A deficiency.



Vitamin D

► Types of Vitamin D

1. Vitamin D₂ (Ergocalciferol) Source
2. Vitamin D₃ (Cholecalciferol) Source

Vitamin D

Functions

- **Hormone-Like Activity:** Vitamin D acts like a hormone in the body, regulating calcium and phosphorus metabolism.
- **Antirachitic Activity:** Prevents rickets, a disease characterized by softening and weakening of bones in young animals.

Deficiency Symptoms

1. **Young Animals:Rickets**-Characterized by weak and deformed bones due to inadequate mineralization.
2. **Adult Animals:Osteomalacia**-Softening of the bones caused by defective bone mineralization.

Sources

- **Vitamin D2:** Found in plants, particularly in fungi and yeast.
- **Vitamin D3:** Found in animal products such as fish liver oils, egg yolk, and synthesized in the skin upon exposure to sunlight.

Vitamin K

► Functions

1. **Synthesis of Prothrombin:** Vitamin K is essential for the synthesis of prothrombin in the liver, a protein and clotting factor that is crucial for blood coagulation.
2. **Blood Clotting:** It plays a vital role in the blood clotting process by activating clotting factors that help in the conversion of prothrombin to thrombin.
3. **Bone Health:** Vitamin K is also involved in the regulation of calcium in bones and other tissues.

► Deficiency Symptoms

1. **Hemorrhagic Conditions:** Deficiency in vitamin K can lead to bleeding disorders due to impaired blood clotting. This can manifest as excessive bleeding from wounds, bruising, and internal bleeding.
2. **Sweet Clover Poisoning:** In cattle, sweet clover poisoning occurs when the plant becomes moldy and produces dicoumarol, a compound that antagonizes vitamin K. This leads to a decrease in prothrombin levels, resulting in hemorrhagic disease.

Vitamin K

► Sources

- Green Leafy Vegetables: Such as spinach, kale, and broccoli.
- Animal Products: Liver, egg yolk, and fish.
- Synthesized by Gut Bacteria: In the intestines of animals.

► Types of Vitamin K

1. Vitamin K1 (Phylloquinone): Found in green plants.
2. Vitamin K2 (Menaquinone): Produced by bacteria in the intestines.
3. Vitamin K3 (Menadione): A synthetic form of vitamin K.

Vitamin E (Tocopherols)

- ▶ Role and Functions
 - Antioxidant: Vitamin E acts as a powerful antioxidant, protecting cell membranes from oxidative damage. It works in association with the selenium-containing enzyme glutathione peroxidase.
 - Free Radical Scavenging: Vitamin E is the first line of defense against free radicals, neutralizing them before they can cause harm.
 - Glutathione Peroxidase: This enzyme destroys any remaining peroxides, preventing further oxidative damage.

Vitamin E (Tocopherols)

▶ Deficiency Symptoms

1. Calves:

- ▶ **Nutritional Myopathy:** Also known as muscular dystrophy or white muscle disease
- ▶ Fatal Syncope: Sudden death due to heart failure.

2. Lambs: Stiff Lamb Disease: Muscle stiffness and weakness due to nutritional myopathy.

3. Pigs: Mulberry: Heart Disease: sudden death due to heart muscle degeneration.

Fatal Syncope: Similar to calves, sudden death due to heart failure.

4. Chicks:

- ▶ Encephalomalacia: Also known as "**crazy chick disease**," characterized by neurological symptoms such as incoordination and convulsions.
- ▶ **Exudative Diathesis:** Edema and hemorrhages due to increased capillary permeability.

5. Cats:

- ▶ Yellow Fat Disease: Also known as **steatitis**, characterized by inflammation of fatty tissues.

Vitamin C (Ascorbic Acid)

► Sources

- Primary Sources: Citrus fruits and green leafy vegetables are rich sources of vitamin C.
- Synthesis: Most animals can synthesize vitamin C in their bodies from glucose using the enzyme gluconolactone oxidase. However, humans, guinea pigs, and some other species lack this enzyme and must obtain vitamin C from their diet.

► Functions

1. Antioxidant: powerful antioxidant, protecting cells from oxidative damage
2. Immune Function: Enhances the immune response and helps in the absorption of iron from plant-based foods.

Vitamin C (Ascorbic Acid)

► Deficiency Symptoms

1. Scurvy: A disease caused by severe vitamin C deficiency, characterized by symptoms such as:
 - Anemia Dry, rough skin covered with reddish spots
 - Weakness and fatigue
 - Swollen and bleeding gums
 - Loosening of teeth
 - Joint pain and swelling
2. Poor Wound Healing: Due to impaired collagen synthesis, wounds may heal slowly.
3. Increased Susceptibility to Infections: Weakened immune response can lead to a higher risk of infections.

Thiamine (Vitamin B1)

Polyneuritis: Inflammation of multiple nerves leading to paralysis.

Chastek Paralysis: A specific type of paralysis seen in animals, particularly in those consuming raw fish containing thiaminase.

Star grazing/opisthotonus

- Antithiamine Factors:
 - ▶ Thiaminase: Found in raw fish and bracken fern, this enzyme breaks down thiamine, leading to deficiency.

Riboflavin (Vitamin B2)

► Functions:

- Component of flavoproteins, flavin mononucleotide (FMN), and flavin adenine dinucleotide (FAD)
- Involved in protein and carbohydrate metabolism
- Used by cells to transport hydrogen in metabolic pathways

► Deficiency Symptoms:

1. **Curled Toe Paralysis**

- Occurs in poultry, especially chicks

2. **Clubbed Down Syndrome/Condition**

- Feathers continue to grow within the follicle, leading to curled feathers
- Affects the appearance and health of the bird's plumage

Niacin (Vitamin B3)/ Nicotinamide

- ▶ Niacin can be synthesized in the body from the amino acid tryptophan.
- ▶ Functions
 - Part of Enzyme Systems: A component of the coenzymes NAD (Nicotinamide Adenine Dinucleotide) and NADP (Nicotinamide Adenine Dinucleotide Phosphate), which are crucial for hydrogen transfer in metabolic reactions.

Vitamin B6 (Pyridoxine)

- Functions: Protein and Amino Acid Metabolism: Acts as a coenzyme in the metabolism of amino acids and proteins.
- Deficiency Symptoms: Convulsions, anemia, slow growth, and hatchability issues in poultry.

Vitamin B5 (Pantothenic Acid)

- ▶ Functions: Component of Coenzyme A: Essential for acyl transfer and fatty acid metabolism.
- ▶ Deficiency Symptoms
 - Pigs: Goose-stepping gait, characterized by a peculiar high-stepping walk.
 - General: Poor growth and skin lesions.

Biotin (Vitamin B7)

- ▶ Functions: Carboxylation Reactions: Acts as a coenzyme for carboxylase enzymes involved in fatty acid synthesis and gluconeogenesis.
- ▶ Deficiency Symptoms
 - Raw Eggs: Contain avidin, which binds biotin and leads to deficiency.
 - Poultry: Fatty liver and kidney syndrome (FLKS), characterized by fat accumulation in the liver and kidneys.
 - General: Dermatitis, poor growth, and cracked feet.

Choline

► Functions

1. Methyl Donor: Choline acts as a methyl donor in transmethylation reactions, which are crucial for fat mobilization.
2. Transition Animals: Helps prevent metabolic diseases such as ketosis in transition animals (e.g., dairy cows around calving).
3. Poultry Chicks: Prevents perosis (slipped tendon), a condition also influenced by manganese (Mn).

► Deficiency Symptoms

- Perosis in Poultry: Characterized by slipped tendon, where the tendon slips from its normal position, leading to leg deformities.

Vitamin B12 (Cyanocobalamin)

► Functions

1. **Synthesis:** Vitamin B12 is synthesized exclusively by microorganisms.
2. **Mineral Requirement:** Requires cobalt (Co) for synthesis.
3. **Absorption:** Absorbed in the gut when bound to a glycoprotein called intrinsic factor, which is produced in the stomach.

► Sources

- **Microbial Synthesis:** Synthesized by microorganisms in the gut.
- **Animal Products:** Found in liver, kidney, and other animal products.
- **Not Present in Plants:** Vitamin B12 is not found in plant-based foods.

► Deficiency Symptoms

- **Pernicious Anemia:** A type of anemia characterized by the inability to absorb vitamin B12 due to the lack of intrinsic factor. Symptoms include weakness, fatigue, and neurological issues.