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Second Class- Animal nutrition

Introduction to Animal Nutrition

Basic Definitions

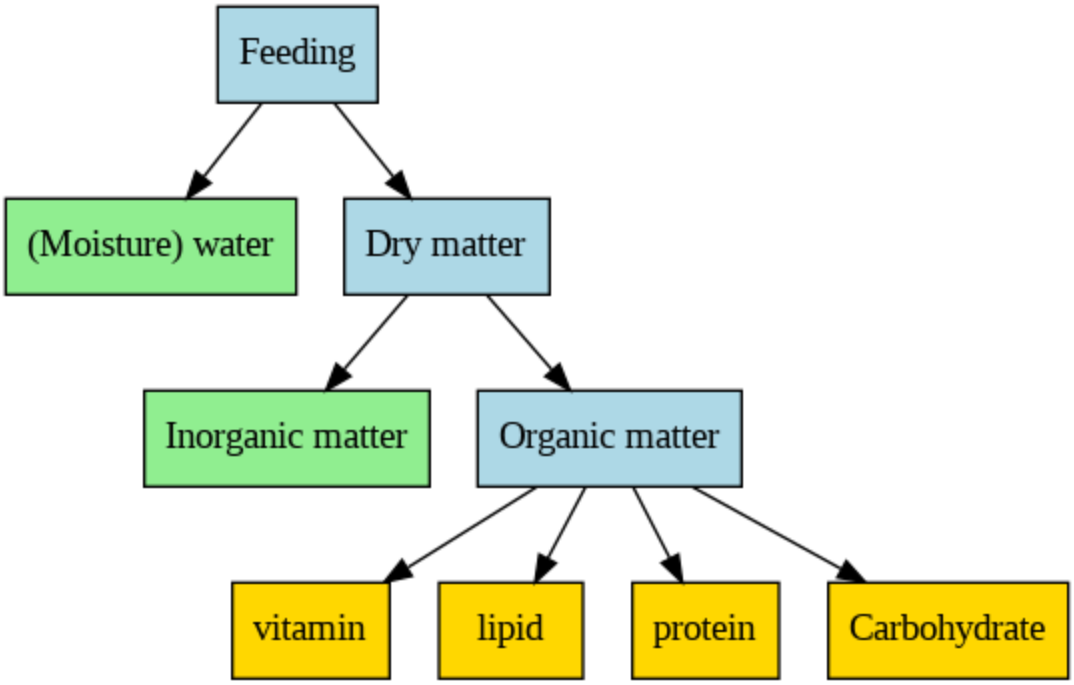
Food: Any substance that can be consumed by the animal and digested within its digestive system, allowing it to be used for energy production, tissue formation, or regulation of vital functions.

Nutrients: The active components within food that the body can utilize.

Nutrition: The science that studies the chemical and physiological processes occurring within the animal's body to transform food into body compounds or energy required for vital and productive activities.

Importance of Animal Nutrition

- Maintaining animal life (Maintenance).
- Providing the energy required for movement and vital activity.
- Building new tissues (growth – replacement of lost tissues).
- Improving production efficiency (meat, milk, eggs, wool).
- Contributing to general health and immunity.
- Reducing production costs through optimal use of local resources.



Chemical Composition of Farm Animals and Plant Feeds

First: The Basic Components of the Animal Body

The animal body is composed of two main parts: **water** and **dry matter**.

1. Water

- Represents **50–80%** of the body weight (up to **95%** in the embryo and **50–60%** in the adult animal).
- The proportion decreases with age and with increasing body fat content.

Functions of Water:

- Transports nutrients in the blood.
- Participates in biochemical reactions.
- Regulates body temperature.
- Facilitates excretion of waste materials.
- Constitutes tissues and vital fluids such as blood, lymph, and digestive juices.

2. Organic Matter

This forms the major portion of the dry matter and includes the following:

A. Proteins

- The main components of muscles, tissues, and organs.
- Represent about **20–22%** of the fat-free body weight.
- Involved in the formation of **enzymes and hormones**.
- Found in all body cells, mainly stored in muscles.

B. Lipids (Fats)

- Serve as the main **energy reserve** in the body.
- Found in **adipose tissues**, under the skin, and around internal organs.
- The proportion varies with species, age, and nutrition (**2–30%**).

  📌 Each gram of fat provides about **9 kcal**, more than twice the energy of carbohydrates or proteins.

C. Carbohydrates

- Represent a small proportion of body weight (**about 1%**), yet are vital as an **immediate source of energy**.
- Found mainly as **glucose in blood** and **glycogen in the liver and muscles**.

3. Inorganic Matter (Minerals)

Also known as **ash**, these account for **4–5%** of body weight.

Macro-minerals:

- **Calcium (Ca):** Essential for bones and teeth formation.
- **Phosphorus (P):** Works with calcium in bone formation and energy metabolism.
- **Sodium (Na), Potassium (K), and Chlorine (Cl):** Maintain osmotic and electrolyte balance.
- **Magnesium (Mg):** Acts as an enzyme cofactor.
- **Sulfur (S):** A component of certain amino acids (methionine, cysteine).

Micro-minerals:

- **Iron (Fe):** Required for hemoglobin formation.
- **Copper (Cu), Zinc (Zn), Manganese (Mn), Iodine (I), Selenium (Se), and Cobalt (Co):** Needed in trace amounts for enzyme and hormone functions.

4. Vitamins

- Present in very small amounts but essential for metabolic activities.
- Divided into two groups:
    - **Fat-soluble vitamins:** A, D, E, and K.
    - **Water-soluble vitamins:** B-complex and Vitamin C.

📌 **Functions:** Regulate growth, blood formation, immune response, and assist in energy metabolism.

Chemical Composition of Plant Feeds

First: Basic Components of the Plant Body

Plant tissues are composed of **water** and **dry matter**, the latter being the nutritive portion utilized by animals.

1. Water

- Represents **10–90%** of plant weight depending on species and growth stage.
- The highest content is found in **green forages** (e.g., alfalfa, green maize).
- Water is essential for **photosynthesis** and nutrient transport within the plant.

2. Dry Matter

This represents what remains after removing water and includes:

A. Carbohydrates

- Form the **largest portion** of the dry matter (**70–80%**).
- Divided into:
    - **Structural carbohydrates:** Cellulose, hemicellulose, and lignin — found in cell walls and form fiber.
    - **Non-structural carbohydrates:** Starch, sugars, and pectins — present in leaves and seeds, serving as the main energy source.

B. Proteins

- Crude protein content varies by plant part:
    - Green forages: **10–20%**.
    - Cereal grains: **8–14%**.
    - Legumes (e.g., alfalfa, soybean): **18–25%**.
- Essential for building tissues, enzymes, and hormones.

C. Lipids (Fats)

- Represent **1–5%** of dry matter in most feeds.
- Higher levels in **oilseeds** such as soybean, cottonseed, and sesame.
- Provide **2.25 times** more energy than carbohydrates.

D. Minerals (Ash)

- Constitute **2–8%** of dry matter and include:
  - **Macro-elements:** Ca, P, K, Na, S, Mg, Cl.
  - **Micro-elements:** Fe, Zn, Cu, Mn, I, Co, Se.
- Involved in bone formation, enzyme activity, and electrolyte regulation.

E. Vitamins

- Plants are the **main source** of vitamins for animals:
  - **Vitamin A** (from carotene) in green forages.
  - **Vitamins E and K** in green leaves.
  - **B-complex vitamins** found in seeds and grains.

F. Secondary Compounds

- Include **tannins, saponins, and alkaloids**.
- Small quantities may enhance digestion or immunity, while high concentrations can negatively affect palatability and digestion.

Functions of Nutrients

Nutrient	Main Functions
Water	Transports nutrients, removes wastes, regulates body temperature.
Carbohydrates	Primary energy source (e.g., maize, barley, wheat).
Lipids	Concentrated energy source, components of membranes and hormones.
Proteins	Build tissues and muscles, form enzymes and hormones.
Minerals	Bone formation (Ca, P), ionic balance (Na, K, Cl), hemoglobin synthesis (Fe).
Vitamins	Act as enzyme cofactors, regulate growth, reproduction, and immunity.

Nutritional Requirements of Animals

- Maintenance: Maintaining basic processes (respiration, circulation, muscular activity).
- Growth: Formation of new tissues.
- Production: Milk, meat, eggs, wool.
- Reproduction: Pregnancy, sperm production.
- Work: Draft animals require additional energy.

Sources of Animal Feed

- Green fodders: alfalfa, green barley, forage maize.
- Dry fodders: hay, straw.
- Grains: barley, corn, oats.
- Industrial by-products: oilseed cakes, molasses, bran.
- Animal feeds: meat meal, fish meal, blood meal.

Water

Introduction

Water is the first and most essential nutrient in animal life.
It constitutes 50–80% of body weight, varying with age, species, and physiological status.
Animals can survive for extended periods without solid feed, but they perish if they lose only 10% of their body water.

Sources of Water in the Animal Body

- Drinking water: The primary source.
- Feed water: Especially in green forages (70–90% water content).
- Metabolic (oxidation) water: Produced from oxidation of nutrients:
  - 1 g fat → 1.07 g water
  - 1 g carbohydrate → 0.6 g water
  - 1 g protein → 0.42 g water

Functions of Water in the Animal Body

- Universal solvent for nutrients and transport to cells.
- Regulating body temperature through:
  - High specific heat (absorbs heat with minimal temperature rise).
  - High latent heat of vaporization (cooling via sweating and respiration).
- Participation in biochemical reactions (hydrolysis).
- Waste excretion via urine, sweat, and feces.
- Maintaining blood pressure and osmotic balance.
- Constituent of body fluids (blood, lymph, cerebrospinal fluid, synovial fluid, eye fluids).
- Assisting digestion (formation of digestive juices and transport of chyme).

Water Requirements of Animals

Depend on:

- Species: Dairy cows require more than sheep and poultry.
- Age: Younger animals have higher water proportions.
- Production: Dairy cows need 4–5 liters of water for each liter of milk produced.
- Type of feed: Dry feeds increase water requirements compared to green feeds.
- Temperature and activity: Hot weather and physical activity increase water intake.

Water Loss from the Body

- Urine: Excretion of nitrogenous wastes and salts.
- Feces: Varies by species (cattle feces are watery – sheep feces are dry).
- Respiration: Water vapor in exhaled air.
- Skin: Sweating/transpiration for cooling.
- Production: Milk contains about 87% water.

Factors Affecting Water Intake

- Type of diet: Fiber-rich or laxative diets increase water intake.
- Climate: High temperatures can multiply water requirements.
- Production level: Milk and egg production increase water demand.
- Dietary protein and mineral content: Higher protein and salt → higher urinary excretion → more water needed.
- Age: Younger animals' bodies contain a higher percentage of water.

Symptoms of Water Deficiency (Dehydration)

- Loss of appetite.
- Reduced activity and lethargy.
- Dry mucous membranes.
- Reduced milk yield.
- Impaired thermoregulation (increased body temperature).
- Severe cases: Death of the animal.