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Theme: Nutrition in plants and animals

S2 New Curriculum Biology-Chapter 3 – Nutrition types and nutrients

Nutrition

Nutrition is the process by which organisms obtain and utilize food for growth, energy, and overall health. It involves consuming essential nutrients—like **carbohydrates, proteins, fats, vitamins, minerals, and water**—to maintain bodily functions and prevent diseases.

There are different types of nutrition:

- **Autotrophic Nutrition:** Organisms, such as plants, produce their own food through photosynthesis.
- **Heterotrophic Nutrition:** Animals and humans depend on consuming food from other organisms.

Types of nutrients

Water

This is the most abundant compound, typically making up of 60-95% fresh mass of an organism.

Uses of water

- (i) It makes up structures of organism
- (ii) It is a solvent
- (iii) It is a reagent in hydrolysis
- (iv) Provide support for aquatic organism
- (v) Is a medium of fertilization through which gametes swim.
- (vi) Medium for removal of waste products
- (vii) Temperature control
- (viii) Hearing and balance as endolymph

Uses of water to the plants

- (i) Aid seed dispersal
- (ii) Provide support to herbaceous plants
- (iii) Breaks up the testa of a seed during germination

- (iv) Reagent in photosynthesis
- (v) Loss of water through the leaves cools the plant.
- (vi) Medium of fertilization

Uses of water to the animals

- (i) A medium of transport
- (ii) Evaporation cools the animal
- (iii) Lubricates joints, eyes, lungs
- (iv) Constituent of protecting fluids such as tears, mucus.

Carbohydrates

Carbohydrates are food substances with a general formula $(CH_2O)_n$ where n is natural number. They are energy giving foods.

Classification

- (i) Monosaccharides e.g. glucose, galactose and fructose

Sources: honey, fruits

Properties

- They are sweet
- Are soluble in water
- They reduce blue copper II ions to red precipitates in alkaline medium.

Testing for reducing sugars

When boiled with Benedict's or Fehling's solutions the color changes from blue to green to yellow to oranges ppt.

- (ii) **Disaccharides**

They are made of two simple sugars as shown in table below

Disaccharides	Composition	Source
Maltose	glucose + glucose	malt
Lactose	Glucose + galactose	milk
Sucrose	Glucose + fructose	Sugar cane Sugar beets
Cellulose	Glucose + glucose	wood

Testing for non-reducing sugars

1. When boiled with Benedict's solution or Fehling's' solution, the color remains blue.
2. When boiled with HCl, the solution cooled, neutralized by NaOH, boiled Benedict's or Fehling's solution, the color changes from green, to yellow to orange.

HCl hydrolyses non-reducing sugars

NaOH neutralizes the excess acid because Benedict's or Fehling's solution does not work in acidic medium.

Polysaccharide $(CH_2O)_n$

These are made of very many mono saccharides per unit molecule e.g. starch and cellulose

Testing for starch

It changes the color of iodine black or blue.

Functions of carbohydrates

1. Glucose, galactose and fructose are oxidized to release energy in the body
2. Glyceraldehyde is an intermediate molecule in photosynthesis.
3. Ribose is component nucleotides.
4. Sucrose is a form in which carbohydrates are transported in plants
5. Lactose is a source of energy in milk
6. Storage of energy (starch in plants, glycogen in animals, inulin in some plants like Dahlia)
7. Formation of cellular structures (cellulose in plant cell walls, chitin in

Lipids

Lipids are made of fats and oils. Fats are solids at room temperature while oils are liquids at room temperature

Uses of lipids

Structural functions

- Make up cell membrane
- Protection: lipids are constituents of the waxy cuticle of plants and insects
- Lipids are water repellent thus prevent water loss from or entry into an animal skin
- Their spongy nature protects delicate organs as shock absorbers.
- Being bad conductors, they reduce water loss from the body when deposited beneath the skin for insulation
- Storage ; they are better storage compounds than carbohydrates due to high calories value, due to high hydrogen content, they are light, insoluble in water, compact to fit in a small volume and are easily used when required.

Physiological functions

- Source of metabolic water
- Store fat soluble vitamins (A, D, E, K)
- Source of metabolic water
- Raw materials for hormones

Testing for lipids

- a. They form a translucent mark on paper that does not disappear when the paper is dried on a flame.
- b. Emulsion test
When 2cm^3 of fats or oil are dissolved in 2cm^3 of absolute ethanol followed by water, a white cloudy suspension is formed.
- c. Sudan III
When a few drops of Sudan III are added to a mixture of 2cm^3 of water and 2cm^3 of oil and shaken, a red stained oil layer separates out.

Advantage of storing fats over carbohydrate

- (i) Has high energy content than carbohydrates
- (ii) It is lighter
- (iii) It is compact and requires less space
- (iv) It is a raw material for hormones
- (v) Insoluble in water that they have low osmotic value

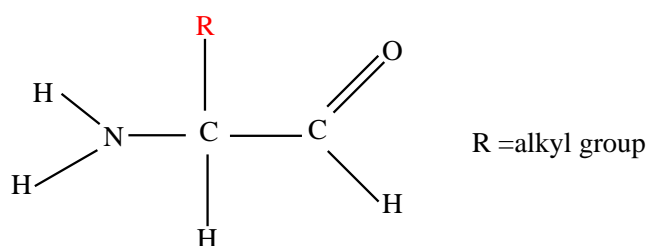
Proteins

These are classified into two groups

- (i) **Structural proteins:** insoluble proteins that make up body structures like bones and muscles. Fibrinogen is a soluble structure protein used in blood clotting.
- (ii) Globular proteins are soluble proteins such as enzymes, antibodies, hormones and so on.

Composition of proteins

The basic unit of proteins is amino acids



There are about 22 different amino acids in the body of which isoleucine, leucine, methionine, phenylamine, proline, threonine and valine cannot be synthesized in human body and they are referred to as **essential amino acids**.

Uses of proteins

- (i) Make up structures, e.g., collagen make up connective tissues.
- (ii) Make up enzymes such as catalyze and amylase.
- (iii) Are constituent of hormone such as insulin
- (iv) Are constituents of antibodies that protect the body from foreign particles.
- (v) Make up muscles such as myosin and actin

- (vi) They are storage food e.g. egg white
- (vii) Constitute toxins such as snake venom for protection.

Testing for proteins

- a. They coagulate on heating
- b. They coagulate on addition of Melon's reagent and on heating they form a pink precipitate.
- c. They form a purple color when mixed with equal amount of NaOH followed by 3 drops of copper sulphate solution.

Vitamins

Vitamins are complex organic compounds present in very small quantities in natural food which are essential for good healthy body and maintains its normal metabolic activities. Some vitamins are fat soluble (ADEK) while others are not.

Vitamin C / ascorbic acid

Sources: citrus fruits, green vegetables, potatoes, tomatoes, etc.

Function of vitamin C

Concerned with the metabolism of connective tissues and the production of strong skin.

Deficient disease : anemia and scurvy: the germs bleed, wounds fail to heal.

Testing for Vitamin C

It decolorizes DCPIP.

Other vitamins and their deficient diseases

Vitamin	
A	Night blindness
K	Delayed clotting
E	Reduced fertility in rats

Functions of vitamins

- protect the body against diseases
- formation of coenzyme that facilitate enzyme reactions
- blood clotting
- components of visual pigment

Balanced diet

A balanced diet is one that provides the body with all the essential nutrients in the right proportions to maintain good health and energy levels. It includes a variety of foods that supply **carbohydrates, proteins, fats, vitamins, minerals, fiber, and water**—all necessary for bodily functions.

Here's what makes up a balanced diet:

- **Carbohydrates:** Provide energy (e.g., whole grains, fruits, and vegetables).
- **Proteins:** Build and repair tissues (e.g., meat, fish, legumes, eggs, and dairy).
- **Fats:** Support cell function and brain health (e.g., nuts, seeds, olive oil, and avocados).
- **Vitamins & Minerals:** Strengthen immunity and overall body function (e.g., fruits, vegetables, and dairy products).
- **Fiber:** Aids digestion and gut health (e.g., whole grains, legumes, and vegetables).
- **Water:** Maintains hydration and supports metabolism.

A well-balanced diet helps prevent diseases, boosts energy, and enhances physical and mental well-being.

Nutrient deficiency in human

Nutrient deficiency in humans occurs when the body doesn't get enough essential nutrients, leading to various health issues. Common nutrient deficiencies include:

- **Iron Deficiency:** Causes anemia, fatigue, pale skin, and dizziness.
- **Vitamin D Deficiency:** Leads to weak bones, fatigue, and an increased risk of infections.
- **Vitamin C Deficiency:** Can result in weak immunity, bleeding gums, and slow wound healing.
- **Vitamin B12 Deficiency:** Causes fatigue, memory problems, and nerve damage.
- **Calcium Deficiency:** Affects bone health, increasing the risk of fractures and osteoporosis.
- **Iodine Deficiency:** Can lead to thyroid problems, such as goiter.
- **Magnesium Deficiency:** Causes muscle cramps, anxiety, and irregular heartbeat.

Eating disorders

Eating disorders are serious mental health conditions that involve unhealthy relationships with food, eating habits, and body image. They can affect physical health, emotional well-being, and daily life. Common eating disorders include:

- **Anorexia Nervosa:** Characterized by extreme food restriction, intense fear of weight gain, and distorted body image. It can lead to severe malnutrition and other health complications.
- **Bulimia Nervosa:** Involves cycles of binge eating followed by purging (vomiting, excessive exercise, or laxative use) to prevent weight gain.
- **Binge-Eating Disorder:** Characterized by consuming large amounts of food in a short period, often leading to feelings of guilt or distress, but without purging behaviors.
- **Avoidant/Restrictive Food Intake Disorder (ARFID):** A condition where individuals avoid certain foods or restrict intake due to sensory sensitivity or fear of adverse effects, rather than concerns about weight.
- **Orthorexia:** An obsession with eating only "healthy" or "clean" foods, leading to restrictive eating patterns that can impact overall health.

These disorders can have serious consequences, but with proper treatment—including therapy, medical support, and nutritional guidance—recovery is possible.

Obesity

Obesity is a medical condition characterized by excessive body fat accumulation that can negatively impact health. It is typically measured using the **Body Mass Index (BMI)**, where a BMI of 30 or higher is classified as obese.

Causes of Obesity:

- **Unhealthy Diet:** High consumption of processed foods, sugary drinks, and excessive calories.
- **Lack of Physical Activity:** Sedentary lifestyles contribute to weight gain.
- **Genetics:** Family history can influence metabolism and fat storage.
- **Medical Conditions:** Hormonal imbalances, thyroid disorders, and certain medications can lead to obesity.
- **Psychological Factors:** Emotional stress and overeating can contribute to excessive weight gain.

Health Risks Associated with Obesity:

- Increased risk of **heart disease, diabetes, high blood pressure, and stroke.**
- Higher likelihood of **joint problems, sleep apnea, and respiratory issues.**
- Can lead to **mental health concerns**, such as low self-esteem and depression.

Managing and Preventing Obesity:

- **Healthy Eating:** Balanced diet with whole foods, vegetables, and lean proteins.
- **Regular Exercise:** Physical activity like walking, jogging, or strength training.
- **Lifestyle Changes:** Managing stress, improving sleep quality, and staying active.

Obesity is a complex condition that can be managed with the right approach.

Plant nutrients

Plants require essential nutrients for growth, development, and survival. These nutrients are categorized into **macronutrients** (needed in large amounts) and **micronutrients** (needed in smaller amounts).

Major Plant Nutrients (Macronutrients)

1. **Nitrogen (N):** Essential for leaf and stem growth, chlorophyll formation, and overall plant health.
2. **Phosphorus (P):** Supports root development, energy transfer, and flowering.
3. **Potassium (K):** Helps with water regulation, disease resistance, and fruit production.

Secondary Macronutrients

4. **Calcium (Ca):** Strengthens cell walls and supports root and leaf development.
5. **Magnesium (Mg):** Essential for photosynthesis as it forms the core of the chlorophyll molecule.
6. **Sulfur (S):** Helps in protein synthesis and enzyme functions.

Micronutrients (Trace Elements)

7. **Iron (Fe):** Crucial for chlorophyll formation and enzyme activation.
8. **Manganese (Mn):** Supports photosynthesis and metabolism.
9. **Zinc (Zn):** Essential for enzyme function and growth regulation.
10. **Copper (Cu):** Helps in photosynthesis and seed development.
11. **Boron (B):** Important for cell wall formation and nutrient transport.
12. **Molybdenum (Mo):** Needed for nitrogen metabolism.
13. **Chlorine (Cl):** Assists in water movement and disease resistance.

Each nutrient plays a unique role in plant health. A well-balanced supply ensures optimal growth and productivity.

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Thanks

Dr. Bbosa Science