

UNIT FOUR Lipids

Learning objectives

At the end of this unit, students will be able to:

- Classify lipids
- Identify the source of lipids
- Explain the importance of lipids
- Describe digestion and absorption of lipids
- Tell the importance of essential fatty acids

Definition

Lipids are a group of organic compounds that are insoluble in water but soluble in organic solvents. Lipids are fats and oils.

Function of Lipids

- The form of stored energy in humans
- Have high energy value 9 kcal/gm of fat
- Act as carriers for fat soluble vitamins
- Are palatable giving good taste and satiety
- Serve as insulator preventing heat loss from the body
- Lubricate the gastrointestinal tract
- Protect the delicate organs such as Kidney, Eyes, heart and the like

Classification of lipids

They classes of triglycerides, fatty acids, trans fatty acids, cholesterol and lipoprotein.

- 1- **Triglycerides:** most dietary fats, called triglycerides, its union of glycerol with three fatty acids.
- 2- **Fatty acids:** the form that is metabolized to produce energy.
 - **Saturated Fatty Acids:** solid at room temperature, full of hydrogen, found in animal fats (butter, lamp, stick margarine, meats, poultry, some dairy products), saturated fats are the unhealthiest fats to eat because they tend to **raise blood cholesterol level.**
 - **Unsaturated Fatty Acids:** liquid at room temperature, found in vegetable oils (mono or polyunsaturated)
 - **Monounsaturated:** such as olive oil, it's a **healthy form**
 - **polyunsaturated:** sunflower oil, corn, cottonseed and soybean.
 - **Essential Fatty Acids:** certain polyunsaturated fatty acids (PUFA) in the diet are **essential to good health** and cannot be made by humans. Only two fatty acids are known to be essential for humans:

- Alpha Linolenic Acid (ALA)= omega-3 fatty acid
- Linoleic Acid (LA)= omega-6 fatty acid

These fatty acids make hormones that regulate the immune system and central nervous system.

- 3- **Trans fatty acids:** are formed when hydrogen is added to unsaturated fats to make them solid. It also called Trans Unsaturated Fatty Acids.

They are manufactured fats created during a process called hydrogenation, which is aimed at stabilizing polyunsaturated oils to prevent them from becoming rancid and to keep them solid at room temperature.

They may be particularly **dangerous for** heart health and may pose a risk for **certain cancers**. Hydrogenated fats are used in stick margarine, fast foods, commercial baked goods (donuts, cookies, crackers), and fried foods.

- 4- **Cholesterol:** waxy substance that is part of every cell in the body in small amounts. It is synthesized in the body from sugars (after glucose is metabolized to Acetyl-Co-A). Our body doesn't need cholesterol from food because it can produce all the cholesterol it needs. It is found in animal fats, egg yolks, liver and kidneys. plant sources have no cholesterol.

Cholesterol performs several functions:

1. It is a major part of brain and nerve tissues
2. It is involved in the formation of cell coverings in the body
3. It is involved in the production of bile salts which help digestion of fat
4. It is involved in the production of vitamin D by sunlight on skin
5. It is involved in the production of a number of hormones including cortisone, aldosterone and sex hormone (e.g. estrogen, and testosterone).

However, excess cholesterol, saturated fats, and trans fats in the diet can **increase bad cholesterol in blood** and worsen atherosclerosis (clogging of the arteries) and associated diseases. Decreasing these fats or replacing them with monounsaturated fats can help reduce these effects. Moreover, hereditary, exercise, and other conditions affect blood cholesterol levels.

- 5- **Lipoprotein:** these are containing both protein and various types and amounts of lipids. They are made mostly in the liver and are used to transport water-soluble lipids (triglycerides and cholesterol) in the blood plasma to all the body.

Lipoproteins are divided according to their density (from the least dense and largest to the most dense and smallest) into: VLDL, LDL, HDL, and Chylomicrons.

- **VLDL: Very low density lipoproteins** are secreted from the liver to carry newly produced triglycerides into adipose tissue.
- **LDL: Low-density lipoproteins** is composed mainly of cholesterol, carry cholesterol from the liver to the rest of the body's cells, and they are called "**bad cholesterol**" because if their levels increase to a certain extent, they can cause arterial disease.
- **HDL: High-density lipoproteins** collect cholesterol from all body tissues and return it to the liver to get rid of it in the form of bile, which is why it is called "**good cholesterol**".
- **Chylomicrons:** they carry triglycerides from the intestine to the liver and adipose tissue.

No recommended dietary allowance has been established for total fat or essential fatty acids; however, the reduction in total fat is recommended.

Digestion of fats

The ability of fat to be digested varies according to its food source and method of preparation, butter is easier to digest than meat fat, exposure of fatty materials to high heat makes it more difficult to digest and can break into irritating substances.

In the mouth: it undergoes a process of chewing and hydration with saliva. The enzyme lipase secreted from the lingual glands contributes to the partial digestion of triglycerides.

In the stomach: partial effect of gastric lipase.

In the small intestine: The real digestion of fatty substances takes place in the small intestine, in which bile secreted from the liver and specific pancreatic and intestinal enzymes participate.

Fat in the duodenum is subject to the effect of pancreatic lipase, which breaks down triglycerides into fatty acids and glycerol at a ratio of 70-80%, and bi- and triglycerides at 20-30%.

The intestinal enzyme Cholesterol Esterase binds free cholesterol with fatty acid = ester cholesterol to make it absorbable.

At the end of fat digestion produces

1. free fatty acids
2. glycerol
3. Bilipids
4. cholesterol esterified

All of these compounds are enteric-absorbable.

In the blood: lipids are released from the intestinal cell in the form of chylomicrons after binding to a protein core.

Discussion questions

1. What are lipids and their importance?
2. How do you classify lipids?
3. What are the essential fatty acids?
4. Explain the process of digestion?
5. Why are people afraid of cholesterol?
6. Discuss LDL, and lipoproteins

UNIT FIVE Vitamins

Learning objectives

At the end of this unit, students will be able to:

- Define vitamins
- Identify the types of vitamins
- Describe the functions of vitamins
- Explain the characteristics of vitamins
- Understand deficiency syndrome of vitamins

Definition

Vitamins are an organic food substance that is necessary in small quantities. The body cannot manufacture the vitamin, thus we must obtain them from the foods we eat, or via vitamin supplements. They are essential for providing good health, prevent diseases, and are necessary for many metabolic and life functions.

Classification of vitamins

1. Vitamin B1 (Thiamine)
2. Vitamin B2 (Riboflavin)
3. Vitamin B3 (Niacin)
4. Vitamin B5 (Panthotonic Acid)
5. Vitamin B6 (pyridoxine)
6. Vitamin B7 (Biotin)
7. Vitamin B9 (Folic acid)
8. Vitamin B12 (Cobalamine)
9. Vitamin C (Ascorbic acid)
10. Vitamin A (Retinol)
11. Vitamin D (Cholecalciferol)
12. Vitamin E (Tocopherol)

13. Vitamin K (Antihemorrhagic vitamin)

These vitamins are found in wholesome foods, milk, vegetables, fruits, eggs, meat, beans, wholegrain cereals etc.

Function of vitamins

- To promote Growth
- To promote Reproduction
- To promote Health & vigor
- To promote Nervous activity
- To promote Normal appetite
- To promote Digestion
- To promote Utilization
- To promote Resistances to infection

Groups of vitamins

Vitamins are classified according to their ability to be absorbed in fat or water as following:

- Water soluble Vitamins are (C and B group): They are travel in the blood and are not stored in the body, therefore they are required daily in small amounts. The excessive amount is readily excreted from the body through urine.
- Fat-soluble Vitamins are (A, D, E, and K): These are oily and hydrophobic compounds, they are stored in the liver and fatty tissues and not readily excreted out of the body. Bile salts and fats are needed for their absorption.

Characteristics of water soluble vitamins

- They are widely distributed in natural foods
- B12 is found only in animal products
- Soluble in water and absorbed in the intestine
- Excess will be excreted, thus not toxic.
- Most functions of these vitamins are as co-enzymes
- They are important for energy production
- They are heat labile

Characteristics of fat - soluble vitamins

- Metabolize along with fats
- Resistance to heat
- Stored in the liver and adipose tissue
- Slow to develop deficiency syndrome

- Present only in certain foods, mostly in animal products, oily foods, yellow and green vegetable
- Excess can be toxic to the body.

Water soluble Vitamins

❖ Vitamin C (Ascorbic Acid)

Vitamin C is unstable and easily destroyed. Cooking itself destroys about half of the vitamin C present in the food. Drying, storage, bruising, cutting, and chopping of fruits and vegetables lead to the loss of vitamin C. Potatoes boiled in their skin retain most of their Vitamin C. Vegetables and fruits should not be left soaked in water for a long time since it is soluble in water. Therefore, the best way to make sure of a regular intake of vitamin C is to eat raw fruits or salad every day.

Functions

- Helps the formation of various body tissues, particularly connective tissues, bones, cartilage and teeth.
- Stimulates the production of red blood cells,
- Helps resistance to infection and neutralizes poisons.

Deficiency

- Contributes to the construction of connective tissue, especially bones, cartilage, teeth and capillary walls.
- Severe deficiency leads to Scurvy. Scurvy's symptoms include weakness, fatigue, restlessness, and neurotic behavior, aching bones, joints, and muscles.
- Necessary for the metabolic processes in the body.
- Helps absorb iron.
- It helps in the quick recovery of infections and wounds.
- Necessary for growth.

Daily need: 35 mg/day

Source: Found in fresh vegetables and citrus fruits

❖ Vitamin B1 (Thiamine)

Functions

- helps to release energy from foods
- promotes normal appetite
- important in maintaining proper nervous system function

Deficiency

Its deficiency leads to **Beriberi disease** in both types **wet** that affect the heart and the circulatory system, or **dry** disease that affects the nervous system and is **manifested by**:

- Lack of appetite, constipation and indigestion.
- Asthenia and nervous irritation due to the lack of glucose oxidation in nerve cells.
- Heart failure and edema of the lower extremities.

Daily need: 1.2 mg/day

Sources: wheat, grains and brewer's yeast

❖ Vitamin B2 (Riboflavin)

Functions

- helps to release energy from foods
- promotes good vision, and healthy skin
- protein synthesis

Deficiency

- delayed wound healing
- commissural fissure
- roughness of the skin
- redness of the tongue
- Corneal vascularization

Daily need: 1.3 mg/day

Sources: Milk, meat, fish and leafy vegetables

❖ Vitamin B3 (Niacin)

Functions

- It affects a number of important metabolic activities needed for the maintenance of healthy skin and the proper functioning of the nervous and digestive system.
- Niacin is a coenzyme in energy metabolism along with other B-complex vitamins.

Deficiency

- Fatigue, poor appetite,
- Weakness, mild digestive disturbance
- Anxiety, irritability
- **Pellagra** (a prolonged niacin deficiency), which is characterized by four D:
 - Diarrhea

- Dermatitis: the skin is dry, scaly, and cracked and the condition is aggravated by exposure to heat or light.
- Dementia and finally
- Death if the disorder is untreated.

Daily need: Males: 16 mg/day; Females: 14 mg/day

Source: grains, meat and vegetables

❖ Vitamin B5 (Panthotonic Acid)

Functions

- healthy skin, hair, and eyes
- proper functioning of the nervous system and liver
- healthy digestive tract
- making red blood cells
- making sex and stress-related hormones in the adrenal glands

Deficiency: Uncommon but can result in acne, numbness, and tingling

Daily need: 5 mg/day

Source: grains, meat and vegetables

❖ Vitamin B6 (Pyridoxine)

Functions

- It contributes to many cellular metabolic processes especially in the formation of neurotransmitters in the brain and nervous system.

Deficiency

- Nervous disturbance such as irritability and insomnia are observed.
- Muscular weakness, fatigue and convulsion have been recorded in infants

Daily need: 1.3 mg/day

Source: Yeast, cereals, eggs, liver and meat.

❖ Vitamin B7 (Biotin)

Functions

- plays a vital role in assisting enzymes to break down fats, carbohydrates, and proteins in food

Deficiency

- impaired growth and neurological disorders.

Daily need: 30 mcg.

Source: sweet potato, eggs, fish and meat.

❖ Vitamin B9 (Folic acid)

Functions

- complementary to the coenzyme of DNA synthesis, and essential in the synthesis of hemoglobin.

Deficiency

- Megablastic anaemia, a type of anemia that causes large red blood cells due to a disorder in the production of DNA.

Daily need: 400 mcg.

Source: leafy green vegetables and liver.

❖ Vitamin B12 (Cobalamin)

Functions

- aids in the building of genetic material
- production of normal red blood cells: synthesis the non-protein part of haemoglobin (heme).
- maintenance of the nervous system

Deficiency

- The red blood cells are abnormally large and reduced in number
- Stomatitis
- Lack of appetite
- Poor coordination in walking & mental disturbance

Daily need: 2.4 mcg.

Source: this vitamin is found only in animal products. Liver, red meat, milk and eggs. Vegetarians who eat no animal products develop a vitamin B12 deficiency only after 20 to 30 years.

Fat-soluble Vitamins

❖ Vitamin A (Retinol Vitamin)

Function

- Composition of the pigment material in the retina (rhodopsin), which enables the retina to adapt to the degrees of light.

- Maintains the integrity of epidermal tissues such as the skin and mucous membranes.
- Necessary for the growth of soft tissues and bone and the regeneration of tissues and germ cells (sperm).

Deficiency

- Night blindness: The child cannot see in the dark. He has to go in to the house early in the evening
- Bitot's Spots: build-up of keratin located superficially in the conjunctiva of human's eyes.
- drying of the cornea
- Ulcers of the mucous membranes.

Reasons of Deficiency

- Inadequate consumption of vitamin A.
- liver stores fail to meet daily metabolic requirements
- Problem of absorption like absence of foods containing oils or fats in the diet
- Repeated infections of diseases such as measles or diarrhea

Daily need: 700 mcg.

Source: The liver stores vitamin A.

- Animal: milk, butter, egg yolk, fish oil.
- Vegetables: It is found in green and leafy vegetables carrots, beets, potatoes, corn, apricots.

❖ Vitamin D (Cholecalciferol Vitamin)

Vitamin D is manufactured by the body as from cholesterol and after exposure to ultraviolet rays.

Functions

- Absorption of calcium and phosphorous
- Works with parathyroid hormone and calcitonin to regulate calcium and phosphorous metabolism.
- The presence of vitamin D is essential to the activity of the parathyroid hormone in removing calcium and Phosphorous from the bone in order to maintain normal serum levels of calcium.
- Stimulates the reabsorption of Calcium by the kidney when serum calcium level is low.
- Bone formation

Deficiency

- In children: rickets and delayed eruption of the teeth.
- In adults: osteoporosis

Reasons of deficiency

- Lack of food intake.

- Not enough exposure to sunlight.
- Gastrointestinal lesions reduce cholesterol absorption.

Daily need: 15 mcg.

Source

- Fish liver oil is a rich source of vitamin D, fish, eggs, milk and its derivatives.
- A non-food source: It is manufactured by the body as from cholesterol and after exposure to ultraviolet rays.

❖ Vitamin E (Tocopherol Vitamin)

Functions

- Antioxidant It protects the cell walls from oxidation.
- It protects muscle cells and red cells from rapid destruction and activates germ cells such as sperm.

Deficiency

- In children: hemolytic anemia.
- In adults: dysplasia of the myelin sheath that covers the nerve fiber.

Daily need: 15 mcg.

Source: It is found in vegetable oils, milk, eggs, fish and cereals.

❖ Vitamin k (Antihemorrhagic Vitamin)

It is composed of two main materials:

Phylloquinone: is found in leafy vegetables.

Menuquinon: is represented by the intestinal flora and represents half of the daily intake of this vitamin.

Functions

- Clotting mechanism of blood: the liver requires vitamin K for the formation of prothrombin or factor 11.
- Bone building: activates the synthesis of specific proteins necessary for bone growth and calcium fixation.

Deficiency

- Tendency to bleed profusely whenever blood vessels are injured

Reasons of deficiency

- Deficiency in intestinal malabsorption
- After treatment with antibiotics that kill intestinal bacteria

Daily need: 80 mcg.

Source: This vitamin can be synthesized by the action of bacteria in the intestinal tract of a healthy person. It is also found in milk, eggs, liver, fish, green vegetables, and some fruits.

Tips for taking water-soluble and fat-soluble vitamins

1. Consult your doctor before taking vitamins, as some vitamins may cause problems with the effectiveness or absorption of some medications.
2. Determining the appropriate dose, especially for fat-soluble vitamins, as taking an amount that exceeds the amount needed for the body may cause some side effects due to its accumulation in body tissues such as the liver, which increases the risk of liver damage.
3. Take fat-soluble vitamins with meals, to improve their absorption into the body.
4. Eating vitamins as nutritional supplements along with a healthy, balanced diet, and not replacing different foods with vitamins.

Discussion questions

1. Define vitamins.
2. State the general functions of vitamins.
3. What are the characteristics of water- and fat-soluble vitamins?
4. Why vitamin A deficiency disease is a very serious health problem?
5. How can we control and prevent vitamin deficiency diseases?