

CHAPTER

5

Applied Nutrition



மாறுபாடு இல்லாத உண்டி மறுத்துண்ணின்
உறுபாடு இல்லை உயிர்க்கு.

There will be no disaster to one's life if one eats with moderation,
food that is not disagreeable.

Learning Objectives

At the end of the lesson students will be able to

- understand the classification of food
- understand the ICMR suggested food pyramid
- know the food source of carbohydrates, fats, and protein
- know in details about vitamins.
- apply therapeutic diets related to hypertension, peptic ulcer, chronic renal failure and Diabetes Mellitus
- know the additives in food



Introduction

To eat is a necessity, but to eat intelligently is an art.

- La Rochefoucauld.

Hippocrates first coined the word clinical nutrition in 4th century B.C. The word diet is derived from the Greek word "data" which means healthful living according to proper reflection of food. The science of nutrition is defined as "the study of the Nutrients in food and the body's handling of them". Nutrition means "the process of nourishing or being

nourished especially, the series of processes by which organism assimilates food and uses it for growth and replacement of tissues".

5.1 Terminology

Nutrition: It may be defined as the science of food and its relationship to health. It is concerned with the part played by nutrients in body growth, development and maintenance.

Dietetics: Dietetics is the practical application of the principles of nutrition. It includes the planning of meals for well and the sick.

Nutrients: A substance in suitable amount is essential for the growth, maintenance, function and reproduction of a cell or organism is called Nutrients. Nutrients consist of carbohydrates, fats, proteins, Vitamins and Minerals.

Macronutrients: Proteins, carbohydrates, and fats are called macronutrients. It supply energy in large quantities to the body and build tissues.

Micronutrients: Vitamins and minerals are called micronutrients. It is needed in small quantity but they play a crucial role to regulate and control body processes.

Malnutrition: Malnutrition is an impairment of health resulting from a deficiency, excess or imbalance of nutrients. It includes under nutrition and over nutrition.

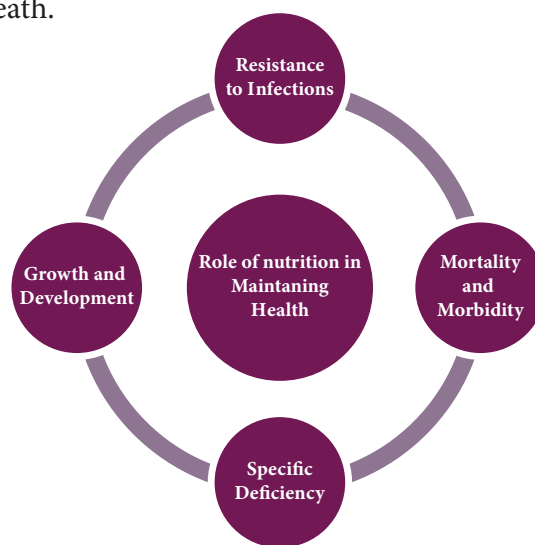
Metabolism: Metabolism is the sum total of building up reactions (anabolism) and breakdown reactions (catabolism) going on inside the body of a living organism.

5.2 Classification of Food

1. Classification by origin
 - Foods of animal origin
 - Foods of plant origin.
2. Classification by chemical composition
 - Protein
 - Fats
 - Carbohydrates
 - Vitamins
 - Minerals
3. Classification by predominant function
 - Body building foods: milk, meat, poultry, fish, egg, pulses, peanuts etc.,
 - Energy giving food: cereals, sugars, roots and tubers, fats and oils.
 - Protective foods: vegetables, fruits and milk.

5.3 Role of nutrition in maintaining health

Nutrition is a basic element of health. Nutrition influence the health from birth to death.



Growth and development

- Good nutrition is essential for attainment of normal growth and development during fetal life and childhood. Physical growth, intellectual development, learning and behavior are affected by malnutrition.
- Adequate nutrition is needed for adult life maintenance for optimum health and efficiency.
- Elder people needs special nutrition due to their physiological and chronological changes. Pregnant and lactating mothers require more proteins and nutrients to prevent abortion, growth retardation and low birth weight babies and provide adequate breast feeding for their babies.

Specific deficiency diseases

- The most common deficiencies find in Indians are Protein energy malnutrition, blindness, goiter, anemia, beriberi, rickets etc. There is increased incidence of abortion, prematurity, still birth and low birth weight babies in malnourished mothers.

- Hence, good nutrition is essential to prevent nutritional deficiency diseases, promotion of health and treatment of deficiency diseases.

Resistance to infection

- A well balanced nutrition prevents infections like tuberculosis. Good nutrition enhances wound healing. Improves resistance of an individual towards infections.

Mortality and morbidity

- Malnutrition leads to increased death rate, infant mortality rate, still births and premature deliveries. Prematurity is the major cause of deaths.
- Over nutrition causes diseases like Obesity, diabetes, hypertension, cardiovascular and renal diseases and causes death.

5.4 Factors affecting food and nutrition

The following factors affects food and nutrition

- Basal metabolic rate
- Weight
- Age
- Sex
- Climate and environment
- Physical activities
- Physiological state
- Socio economic factors
- Cultural factors
 - Life style and food habits
 - Food fads
 - Cooking practices
 - Child rearing practices
- Religion

- Traditional factors
- Food production and distribution.

Food Pyramid

According to Indian Council of Medical Research, foods are grouped as shown in Pyramid according to the requirement for healthy life.



Each food groups is a source of different nutrients. Balanced diet should include all the food groups.



One of the world's healthiest food is lemon. One lemon contains our daily dose of vitamin C it cleanses our liver, boost our immunity and aids in weight loss.



5.5 Carbohydrates

Carbohydrates are the main source of energy for daily activities. Carbohydrates (primarily starches) are the least expensive, the most available, easily obtainable and readily digestible form of nutrient.

Composition of Carbohydrates

Carbohydrates are organic compounds of carbon, hydrogen and oxygen with the latter elements in the ratio of 2: 1. The general formula is $C_6H_{12}O_6$. Carbohydrates are widely

Table -1 - Food Groups Suggested by ICMR (2011)

Nutrient content of food groups	Nutrients
<p>1. Cereals, Millets and Pulses:</p> <p>Rice, Wheat, Ragi, Bajra, Maize, Jowar, Barley, Rice flakes, Wheat flour, Breakfast cereals.</p> <p>Pulses and Legumes: Bengal gram, Black gram, Green gram, Red gram, Lentil (Whole as well as dhal), Cowpea, peas, Rajmah, Soya bean, Beans.</p>	<p>Energy, Protein, Invisible fat, Vitamin B₁, Vitamin B₂, Folic acid, Iron, Fiber.</p> <p>Energy, Protein, Invisible fat, Vitamin B₁, Vitamin B₂, Folic acid, Calcium, Iron, Fiber.</p>
<p>2. Milk and Animal products:</p> <p>Milk, Curd, Skimmed milk, Cheese, Chicken, Liver, Fish, Egg, Meat.</p>	<p>Protein, Fat, Vitamin – B₁, Vitamin B₂, Calcium, Iron</p>
<p>3. Vegetables and Fruits:</p> <p>Fruits: Mango, Guava, Tomato, papaya, Orange, Sweet lime, Water melon.</p> <p>Green leafy vegetables: Amaranth, Spinach, Gogu, Drumstick leaves, Coriander leaves, Fenugreek leaves.</p> <p>Other vegetables: Carrots, Brinjal, Ladies finger, Beans, Capsicum, Onion, Drumstick, Cauliflower</p>	<p>Carotenoids, Vitamin C, Fiber, Invisible fat, Vitamin B₂, Folic acid, Iron.</p> <p>Carotenoids, Vitamin B₂, Folic acid, Calcium, Iron, Fiber.</p> <p>Carotenoids, Folic acid, Calcium, Fiber.</p>
<p>4. Oils, Fats and Nuts:</p> <p>Fats: Butter Ghee, Hydrogenated fat, Cooking oils like groundnut, mustard, Sunflower.</p> <p>Sugar: Jaggery and cane – sugar.</p> <p>Almonds, walnuts and gingelly seeds</p>	<p>Energy, Fat, Essential fatty acids.</p> <p>Energy</p> <p>Protein, ω-3 fatty acids.</p>

distributed in plants. Foods which contain carbohydrates are called energy foods.

Classification of Carbohydrates

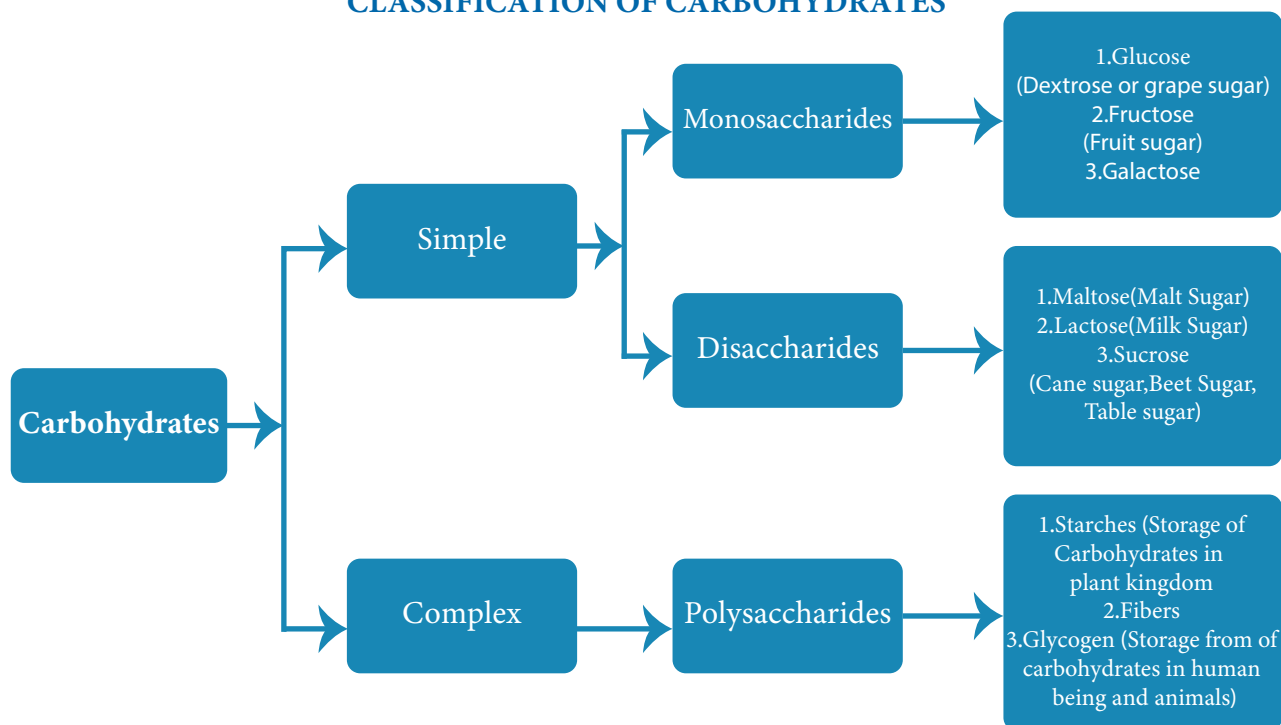
Carbohydrates are classified according to the number of saccharide (sugar) groups present. They are broadly classified as simple carbohydrates and complex carbohydrates. The simple carbohydrates include monosaccharides (Single sugar) and disaccharides (Double sugars). Complex carbohydrates include starch, glycogen and fibers. The classification of carbohydrates is schematically represented below:

Recommended daily allowances

Table: 2

Age Group	Recommended carbohydrate/Gms/day
Adults	50 – 70
Expectant and nursing mothers	40 – 60
Infants (1 – 12months)	40 – 50
Preschool children (1-25years)	40 – 60
Older children and adolescents	50 - 70

CLASSIFICATION OF CARBOHYDRATES



Dietary sources

The important sources of carbohydrates in the diets are cereals, millets, roots, tubers pulses, sugar and jaggery.

Table: 3

Food	Carbohydrate g / 100 g
Cereals and millets (rice, jowar)	63 – 79
Pulses (Bengl gram, red gram, etc)	50 – 60
Nuts and oilseeds	10 – 25
Roots and tubers	22 – 39
Arrow root flour	85 – 87
Cane sugar	99
Sago	87 – 89
Honey	79 – 80
Jaggery	94 – 95
Milk	4 – 5
Dried fruits	67 – 77
Fresh fruits	10 - 25

Functions

1. Supply energy for body functions and for doing work. Each gram of carbohydrate yield 4 kcal of energy.
2. Essential for the oxidation of fats
3. Exert a sparing action on proteins.
4. Provide carbon skeleton for the synthesis of some non – essential amino acids.
5. Add flavor to the diet.

Digestion, absorption and storage, metabolism of carbohydrates

The first stage of digestion takes place in the mouth while the food is chewed. In saliva the enzyme called alpha – amylase which is called as ptyalin acts on starch. The enzyme acts on starch splitting it into dextrin and maltose. As soon as the food reaches the stomach it mixes with acidic gastric juices for digestion. The main digestion takes place in the intestines.

The final products of digestion of carbohydrates are glucose, fructose and galactose, these products are absorbed in the intestines. The non – digestible carbohydrates present in the food such as cellulose, hemicelluloses, pentosans, galactans, fructosans etc add bulk to the contents of large intestine and are excreted in the faeces.

Storage, metabolism of carbohydrates

Glucose, galactose and fructose absorbed in the intestines pass through the portal circulation to the liver. In the liver a part of the glucose and the entire galactose and fructose are converted into glycogen. A portion of glucose enters into the general circulation and to the various tissues for being oxidized and used as energy. A small portion of the glucose is stored in liver and muscle as glycogen and some portion of the glucose is converted into fat and stored in adipose tissue. The oxidation of glucose in the tissues occurs in two stages as indicated below;

1. Glycogen \longrightarrow Glucose \longrightarrow Pyruvic acid
 \longrightarrow Lactic acid
2. Pyruvic acid $\xrightarrow{\text{Oxidation}}$ $\text{CO}_2 + \text{H}_2\text{O}$

The first stage is called 'glycolysis'. The oxidation of pyruvic acid takes place through a series of reactions known as tricarboxylic acid cycle (Krebs's cycle).



Drinking tea / coffee can severely inhibit your body's ability to absorb vitamins and minerals – especially Iron.

Deficiencies

A deficiency of carbohydrates makes the body to utilize fats for energy, if it is not rectified it leads to ketone bodies formation which occurs due to oxidation of fats.

Excessive carbohydrates

Excessive consumption of carbohydrates leads to heart disease, diabetes, and obesity.

5.6 Fat

The name fat may make it sound like something you shouldn't eat. But fat is an important part of a healthy diet. Fat from your diet gives you energy. As a bonus, fat in food helps you feel full, so you don't eat too much.

Some foods, including most fruits and vegetables, have almost no fat. Other foods have plenty of fat. They include nuts, oils, butter, and meats like beef.

The lipids are a heterogeneous group of substances found in plant and animal tissues, which share the property of being relatively insoluble in water, and soluble in organic solvents, such as ether, chloroform and benzene. Fat contain 9 kcal per gram.

Functions of fats

1. They are the chief energy stores of the body, which form an important source of energy during starvation or other emergencies.
2. Fats play a role in the absorption of fats soluble vitamins like vitamins A, D, E and K.
3. Fats are the constituents of cell membrane structure and regulate the membrane permeability.
4. Subcutaneous fat acts as an insulator and helps in retaining body heat.
5. Fats are important as cellular metabolic regulators (Steroid hormones and prostaglandin).
6. Fat is the main energy store in the body and the most concentrated source of energy in the diet – 1 g of fat provides 37kJ (9Kcal), more than double that provided by either protein or carbohydrate (4Kcal).

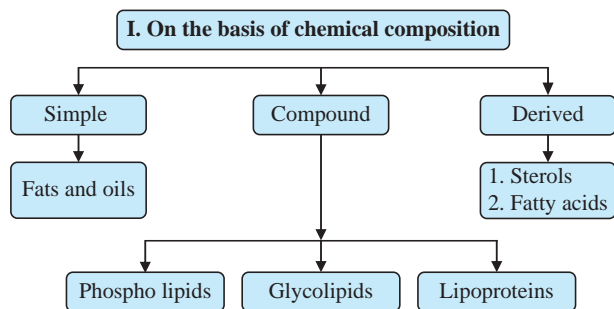


World Food Day – October 16

Classification of lipids

Lipids are classified into 4 categories as follows:

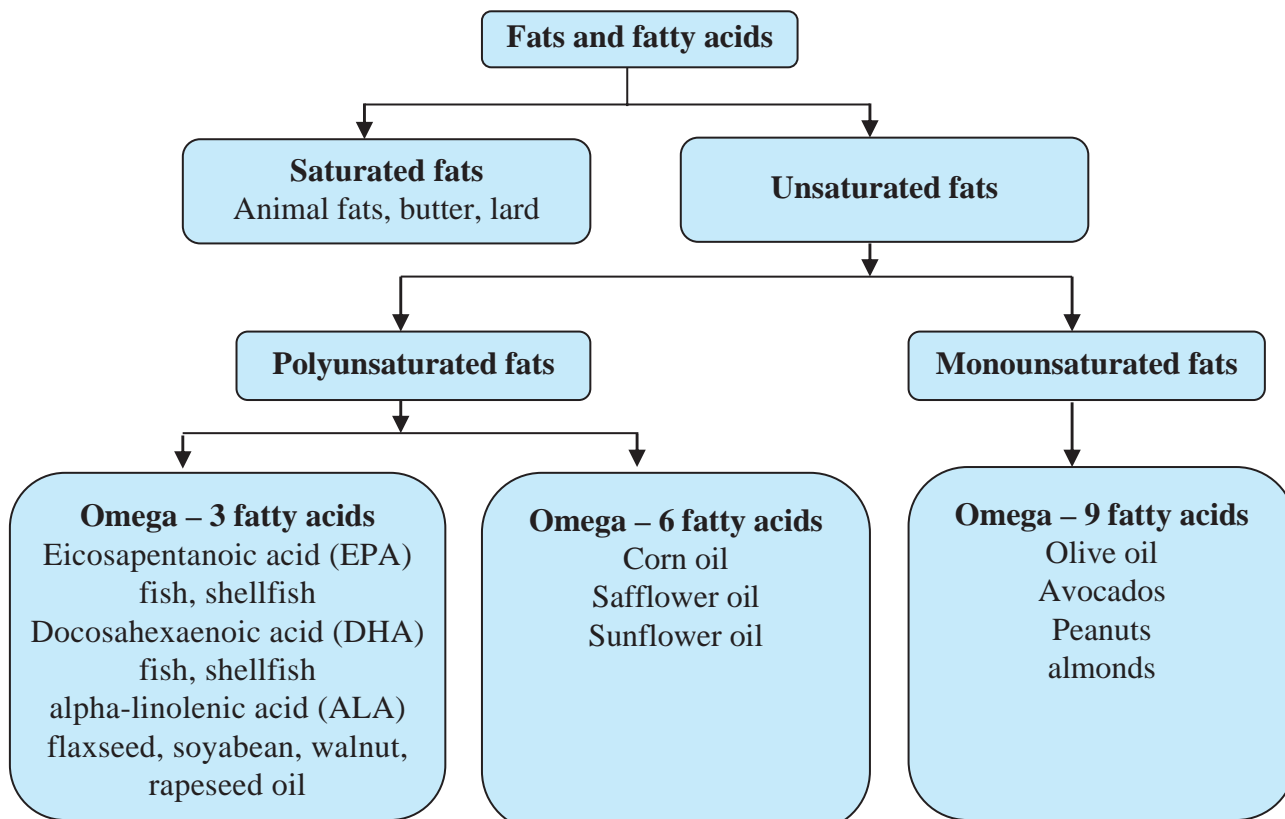
I. On the basis of chemical composition



II. On the basis of sources

Fats are divided into 2 types based on their source, namely **visible** and **invisible** fats.

III. On the basis of fatty acids



IV. On the basis of requirement

Fatty acids are of 2 types:

1. Essential fatty acids: Fatty acids which are essential to be taken in our diet because they cannot be synthesized in our body are known as essential fatty acids. (eg.) Linoleic, linolenic and arachidonic acids.
2. Non-essential fatty acids: Non-essential fatty acids are those which can be synthesized by the body and which need not be supplied through the diet. Palmitic acid, oleic acid and butyric acid are examples of non-essential fatty acids.

Digestion, absorption and storage metabolism

Fats are not digested in the stomach. Fats delay emptying of the stomach. Fats are hydrolyzed by the pancreatic and intestinal lipases in the intestines into diglycerides, monoglycerides and fatty acids. Bile is essential for the digestion and absorption of fats.



Sources of fat

Storage of fats

Fat is stored in the adipose tissues. In normal human beings adipose tissue constitutes of 10 – 15% of the body weight.

Fat metabolism

Fatty acids are oxidized by certain enzymes in the tissues to carbon dioxide and water. The oxidation takes place through the tricarboxylic acid cycle.

Deficiencies

• Dry, scaly skin	• Poor growth
• Hair loss	• Lower resistance to infection
• Low body weight	• Poor wound healing
• Cold intolerance	• Loss of menstruation
• Bruising	

Over consumption

- Over weight

- Obesity
- Coronary heart disease
- Cancer
- High cholesterol

5.7 Proteins

Proteins are made of amino acids linked together by peptide bonds. Amino acids can be divided into essential amino acids and non – essential amino acids. Proteins and carbohydrates contain 4 kcal per gram.

Composition

Proteins are chemical compounds that contain the same atoms as carbohydrate and lipid – carbon (C), hydrogen (H) and oxygen (O) – but proteins are different in that they also contain nitrogen (N) atoms. These nitrogen atoms gives the name ‘amino’ (nitrogen containing) to the amino acids that are the links in the chains referred to as proteins.

Classification of proteins

Proteins are large molecules formed by the combination of a number of aminoacids. About 20 amino acids have been found to occur in proteins and are important from the point of view of human nutrition.

Table 4

Classification of Proteins (Based on chemical composition)				
Simple		Conjugated	Derived	
Globular proteins	Scleroproteins	• Nucleoproteins	Primary	Secondary
• Albumins	• Collagens	• Glycoproteins	• Coagulated	• Proteoses
• Globulins	• Elastins	• Mucoproteins	Proteins	• Peptones
• Glutelins	• Keratins	• Lipoproteins	• Proteans	• Polypeptides
• Prolamines		• Phosphoproteins	• Metaproteins	• Peptides
• Histones		• Chromoproteins		
• Globins		• Matalioproteins		
• Protamines				

Sources of protein

- Excellent sources of protein include tuna, shrimp, turkey, and cod.
- Very good sources of protein include snapper, venison, halibut, salmon, scallops, chicken, lamb, beef, calf's liver, spinach, tofu, mustard greens, mushrooms, soybeans, and mozzarella cheese.
- Good sources of protein include eggs, milk, collard greens, cauliflower and many legumes including lentils, split peas, kidney beans, black beans, pinto beans and garbanzo beans.



Sources of Protein

Table 5

Nutritional classification of amino acids		
Essential	Semi-essential	Non-essential
Histidine	Arginine	Glutamic acid
Lysine	Tyrosine	Aspartic acid
Tryptophan	Cystine	Alanine
Phenylalanine	Glycine	Proline
Methionine	Serine	Hydroxyproline
Threonine		Cysteine
Leucine		
Isoleucine		
Valine		

Functions of protein

- Production and maintenance of structural proteins

- Production of enzymes and hormones
- Production of transport proteins and lipoproteins
- Production of antibodies
- Maintenance of proper fluid balance
- Maintenance of proper acid – base balance.

Protein deficiency diseases – Maras muss and kwashiorkor

Table: 6

Recommended daily protein allowances			
Group	Particulars	Protein allowance	
		(g/kg/day)	(g/day)
Man (60kg)	Sedentary work	1	60.0
	Moderate work		
	Heavy work		
Woman (50kg)	Sedentary work	1	50.0
	Moderate work		
	Heavy work		
	Pregnancy		
	Lactation (0 go 6m)	1	+25.0
Infants	0 to 3 Months	2.3 (a)	
	3 to 6 months	1.8 (a)	
	6 to 9 months	1.65 (b)	
	to 12 months	1.5 (b)	
Children	1 to 3 years	1.83	22.0
	4 to 6 years	1.52	30.0
	7 to 9 years	1.46	41
Adolescents	Males		
	to 12 years	1.46	54
	13 to 15 years	1.40	70
	16 to 18 years	1.31	78
	Females		
	to 12 years	1.45	57
13 to 15 years	1.33	65	
16 to 18 years	1.21	63	

5.8 Vitamins

Vitamins are essential organic, compounds that are needed in small amounts in the diet both to prevent deficiency diseases and to support optimal health. The term vitamin (vital amines) was coined by Casmir Funk. The term vital denoting essential for life and amines because these compounds contained an amine functional group.

Characteristics of vitamins

- Vitamins are vital, organic, dietary substance that is necessary in only very small amounts to perform a specific metabolic function or prevent an associated deficiency disease.
- Vitamins are not synthesized by the body and therefore must be supplied through food.

Table: 7

Fat – Soluble Vitamins	Water – Soluble Vitamins
Vitamin A	Vitamin C
Vitamin D	B – Complex vitamins (8)
Vitamin E	Thiamine
Vitamin K	Riboflavin
	Niacin
	Pyridoxine
	Folate
	Cyanocobalamin
	Biotin
	Pantothenic acid

Functions of Vitamins

Each vitamin has its specific metabolic task. However the general functions are:

- Function as control agents in cell metabolism
- Components of body – tissue construction.
- Prevent specific nutritional deficiency disease, which is considered as a result of their primary role in cell metabolism.

Classification of Vitamins

Thirteen (13) recognized vitamins classified in two groups, based on their solubility in fat or in water are as follows:

Fat – soluble vitamins

The four fat – soluble vitamins – vitamins A, D, E and K are often present in the fat portion of foods, they are not easily lost from foods or destroyed by exposure to water, heat, air, or light.

Vitamin A (retinol and beta – carotene)

Vitamin A and carotene can be obtained from either animal or vegetable sources. The animal form is divided between retinol and dehydroretinol whereas the vegetable carotene can be split into four very potent groups– alpha– carotene, beta–carotene, gamma carotene and crypto– carotene.

Function

Vitamin A has a variety of functions in the body. It is required for the synthesis of rhodopsin and other light – receptor pigments in the eye and thus is essential for vision. Vitamin A is needed for normal growth and development to occur in the body, including the formation of bone and cartilage.

Healthy epithelial or skin cells, which line surfaces inside and outside the body, require vitamin A. Vitamin A plays a role in reproduction, metabolism, and immune system function also.

Digestion and absorption

Retinol esters in food are hydrolyzed by pancreatic and intestinal enzymes to form free retinol. After absorption, the retinol, is reesterified and transported to blood.

Carotenes are split in the intestines to form retinaldehyde, which is then reduced to



Table 8: A summary of the fat soluble vitamins

Vitamin	Functions	RDA	Deficiency Symptoms	Toxicity
Vitamin A	Aids in vision, especially night vision promotes growth, development, reproduction, healthy skin cells, and health immune system acts as an antioxidant	Men : 1000 retinol equivalents (RE) 5000 1 μ	Short – term: Night blindness, flaking skin. Long term : Xerophthalmia (dry, hard cornea); progresses to softening of corneas and blindness if untreated	Toxic symptoms appear with chronic intake of 10 times the RDA, usually due to supplement abused. Symptoms include lack of appetite; dry, itch skin; loss and coarsening of hair; liver damage; fetal defects and miscarriage.
Vitamin D	Aids in absorption, transport, and use of calcium and phosphorus Maintains optimal blood calcium levels	5 – 10 μ g	Rickets (faulty bone formation) in children. Osteromalacia (Softening of bones) in adults	Toxic symptoms appear with regular intake of 5 times the RDA, usually due to supplement abuse. Symptoms include lack of appetite, high blood pressure, excessive thirst and urination, high blood calcium and calcium deposits in tissues, kidney stones, and kidney failure can lead to death.
Vitamin E	Acts as an antioxidant, protecting cell membranes from oxidative damage.	20 – 25 mg	Damage to all membranes, leading to destruction of red blood cells (hemolytic anemia) Rare in humans except in premature infants and those with certain diseases	Relatively nontoxic; use of supplements with 80 times or more of the RDA may cause symptoms. Symptoms include muscular weakness, fatigue, and nausea.
Vitamin K	Promotes formation of some blood – clotting factors	Men : 70 – 80 μ g Women : 60 – 65 μ g	Poor blood clotting, possibly leading to hemorrhage (Rare in humans excepts in newborn infants and people on long term general antibiotic therapy)	Natural forms are nontoxic; excessive synthetic supplementation can cause toxic symptoms in infants. Symptoms include anemia and jaundice.

retinol. Some carotene may be absorbed intact and later converted to vitamin 'A' in the liver or kidney. Bile is necessary for the absorption of vitamin A and carotene. Vitamin E in the intestinal tract prevents oxidation of the vitamin. Mineral oil hinders absorption since it dissolves the vitamin but is not absorbed.

Food sources



Sources of Vitamin A

Liver, milk, egg – yolk, carrots, dark green leafy vegetables and yellow fruits are high in vitamin A or beta – carotene.

Deficiency

A diet deficient in vitamin A for several months may lead to night blindness and flaking skin.

A long – term vitamin A deficiency leads Xerophthalmia, major symptom of which is dry, hard cornea. If this condition is left untreated, damage to the cornea progresses, leading to a softening of the cornea and eventually total blindness.

Vitamin A deficiency also affects the skin, causing it to become dry and rough.

If xerophthalmia and the underlying vitamin A deficiency are treated at an early stage, blindness can be prevented.

Vitamin D (Calciferol)

The human body can produce vitamin D from cholesterol present in the skin. This conversion depends on exposure of the skin to the ultraviolet rays in sunlight and yields

inactive pro-vitamin D. Both inactive vitamin D formed in the skin and vitamin D absorbed from dietary sources are transported through the bloodstream to the liver, where they are stored.

Functions

- Vitamin D helps with the absorption, transport and use of calcium.
- Vitamin D assists in bone growth and the integrity of bone and promotes strong teeth.
- It also helps to regulate the amount of phosphorus in the body as well as assisting in a healthy heart and nervous system.

Food sources



Sources of Vitamin D

Vitamin D is present in fatty fish like kipper, sardines, salmon, tuna and mackerel, liver, egg yolk and butter. Smaller amounts are also present in dark leafy vegetables.

Absorption

Dietary vitamin D is absorbed along with dietary fats in the small intestines and transported to the lymph system. Bile is essential for the absorption of this vitamin. Excess vitamin is stored in the body.



Which is the only non-animal natural source of vitamin-D – Mushroom. The best source of vitamin D is Sun.

Deficiency

Vitamin D deficiency affects the mineralization of bones and teeth.

-Rickets, osteomalacia

Vitamin E (Tocopherol)

Vitamin E is an essential, fat – soluble vitamin that includes eight naturally occurring compounds in two classes designated as tocopherols and tocotrienols.

Vitamin E is an effective chain – breaking, lipid – soluble antioxidant in biological membranes, and aids in membrane stability.



Sources of Vitamin E

Function

- Vitamin E is a powerful antioxidant.
- Antioxidant capability helps to prevent degenerative diseases.
- Vitamin E is also useful in preventing blood clots forming and promotes fertility.
- An increase in stamina and endurance is also attributed to vitamin E.
- Vitamin E is also used to great effect for skin treatments.

Deficiency of vitamin E

Deficiency of vitamin E is a not common, and the symptoms not very clear cut, but may include fatigue, inflamed varicose veins, slow wound healing, premature ageing and sub – fertility.

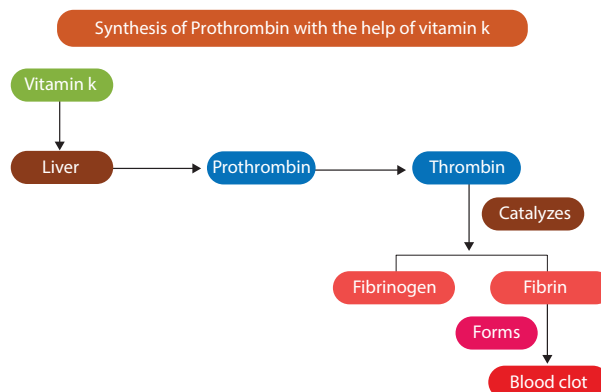
Vitamin K

Vitamin K can be produced in the intestines and this function is improved with

the presence of cultured milk, like yogurt, in the diet.

Functions

- The major function of vitamin K is to promote coagulation of blood after injury, thereby preventing haemorrhage.
- Vitamin K is necessary for the synthesis of prothrombin, an inactive form of thrombin.
- It is involved in the formation of prothrombin.
- It is also involved in bone formation and repair.



Food Source



Sources of Vitamin K

The best dietary sources of this vitamin are green leafy vegetables, cheese and liver.

Deficiency

Increased tendency to haemorrhage defective blood clotting

Table: 9 Water soluble vitamins

Vitamin	Functions	RDA
Vitamin C	Involved in synthesis of collagen, and norepinephrine Promotes immune – system functioning, acts as antioxidant	60 – 70 mg
Thiamine	Coenzyme involved in catabolism of carbohydrates to yield energy	Men : 1.2 – 1.6 mg Women : 1.1 – 1.5mg
Riboflavin	Coenzyme involved in many energy – yielding pathways	Men: 1.4 – 1.9 mg Women 1.1 – 1.5mg
Niacin	Coenzyme involved in nearly all / energy – yielding path – ways and in synthesis and breakdown of fats	Men : 16 – 12 Women 12 – 16 mg
Pyridoxine	Coenzyme involved in proteins and amino acids synthesis	2.0 mg
Folate	Coenzyme involved in amino acid metabolism and synthesis of DNA	100µµg
Cyanocobalamin	Various coenzymes involved in energy metabolism; work with folate in synthesizing methionine	2 - 10µµg
Biotine	Coenzyme involved primarily in gluconeogenesis, fatty acid synthesis, leucine metabolism and synthesis of purine structure carbohydrate and lipid metabolism	30 – 100 µµg
Pantothenic acid	Coenzyme form (coenzyme A) involved in carbohydrate, lipid, and protein metabolism	4 – 7 mg



Sources	Deficiency Symptoms	Toxicity
Dietary, excellent sources; citrus fruits and their juices, sweet red and green peppers, strawberries, cantaloupe, broccoli, Brussels sprouts, papaya, cauliflower. Good sources: potatoes, tomatoes, peas, kale, asparagus, cabbage.	Scurvy: fatigue, bleeding gums, poor appetite, slow wound healing, muscle fatigue. Seen occasionally in infants fed only cow's milk and in elderly people	Relatively nontoxic; supplement abuse may cause diarrhea
Dietary, excellent sources: pork, sunflower seeds, fortified grain products, fresh peas. Good sources: legumes, whole and enriched grains	Beriberi: poor coordination, Muscle weakness, edema, heart diseases	Nontoxic except for high dose injections.
Dietary, excellent sources: liver, milk and milk products Good sources: oysters, mushrooms, green vegetables (broccoli, spinach, asparagus)	Ariboflavinosis: inflammation of the mouth and tongue, cracks at the corners of the mouth and lips, anemia, dermatitis, eye – related problems	Nontoxic
Dietary, excellent sources: tuna, chicken, liver, beef, fortified cereals. Good sources: Mushrooms, whole grains	Pellagra: diarrhea, dermatitis, dementia, and possibly death (the four Ds) common in Africa and Asia	Nicotinic acid form is toxic with high dose supplements. Symptoms include flushing (>100 mg); liver damage, increased levels of uric acid and glucose in blood (>3 grams); increased use of glycogen during exercise.
Dietary, excellent sources: liver, potatoes, bananas, prune juice, light poultry meat, fortified grain products Good Sources : Sweet potatoes, water – melon	Convulsions, dermatitis, inflamed tongue, and anemia. Deficiency symptoms often seen in alcoholics, the elderly, and women taking birth control pills	Toxic with long – term supplement abuse (>1 gram per day). Symptoms include nerve damage and lack of muscular control (usually reversible)
Dietary, excellent sources: legumes, liver spinach and turnip greens, artichokes. Good sources : asparagus, oranges, green peas, broccoli, beets, beet greens, green beans, corn	Macrocytic megaloblastic anemia, diarrhea, mental confusion, depression, fatigue.	Nontoxic
Dietary, excellent sources: organ meats, shellfish, milk and milk products (found only in animal foods)	Pernicious anemia: a macrocytic megaloblastic anemia accompanied by nerve damage. Most commonly results from poor absorption due to lack of intrinsic factor, not from low dietary intakes of vitamin	Nontoxic
Dietary, excellent sources: liver, soy flour, egg yolks. Dietary, good Sources: cereals. Nondietary: synthesized by bacteria in the intestinal tract.	Poor appetite, nausea, sore tongue, depression, pallor, hair loss, dry skin, increased blood levels of cholesterol and bile Rare in humans.	Nontoxic
Dietary, excellent sources: egg yolks, liver, kidney. Dietary, good sources: meat, legumes, whole grains	Deficiency symptoms are rare. In severely malnourished individuals symptoms such as paresthesia in the toes and soles of feet, burning sensations in the feet, fatigue, insomnia, depression may be seen	Nontoxic

Water – soluble vitamins

Water – soluble vitamins are essential for health, and each one has its own function in the body and due to its solubility in water. It is normally easily lost in urine. The water soluble vitamins include vitamin C and 8 B complex vitamins – thiamine, riboflavin, niacin, pyridoxine, folate, cyanocobalamin, biotin and pantothenic acid. Most of these are unstable and thus easily destroyed by exposure to water, heat, air or light.

Vitamin C

Many fruits and vegetables are rich in vitamin C, also known as ascorbic acid. To ensure optimal physiological functioning and to prevent subclinical deficiencies, a person needs to consume a good source of vitamin C every day because the body normally stores only small amounts of Vitamin C.



Sources of Vitamin C

Functions

- Vitamin C is required in the synthesis of collagen in connective tissue, steroid hormones, carnitine, etc.
- Vitamin C is required for the conversion of cholesterol to bile acids.
- It enhances iron bioavailability.
- Ascorbic acid is a great antioxidant and helps to protect the body against pollutants.

- Ascorbic acid also promotes healthy cell development.
- Vitamin C is essential for the formation and maintenance of intercellular cement substances such as bone matrix, cartilage dentine, collagen, connective tissue, etc.
- Vitamin C is needed for healthy gums and to protect against infection.

Food sources

Good sources of vitamin C are green leafy vegetables, berries, citrus fruits, guavas, tomatoes, melons, papayas, etc.

Deficiency

In infants and children, vitamin C deficiency results in defective bone formation leading to retardation of growth.

B – complex vitamins

The eight B – complex vitamins include thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), cyanocobalamin (B12), folic acid, biotin (B7), and pantothenic acid. The B vitamins are easily lost in cooking water because they are water soluble. With the exception of niacin, all other B vitamins lose some activity when exposed to heat, oxygen, light, or alkaline conditions.

Thiamine (Vitamin B1)

Thiamine also called B1 is used in many different body functions and deficiencies may have far reaching effects on the body, yet very little of this vitamin is stored in the body and depletion of this vitamin can happen within 14 days. Thiamine is integrally involved as a coenzyme in the catabolism of carbohydrates to yield energy.

Functions

- It is also required for the health of the nervous system.
- It is used in the manufacture of hydrochloric acid, and therefore plays a part in digestion.

- In children it is required for good appetite and proper growth.

Food sources



Sources of Vitamin B

Sunflower seeds, peanuts, wheat bran, beet liver, pork, seafood, egg – yolk, beans whole grains and yeast contain good amounts of thiamine.

Deficiency

Beriberi occurs in two forms, wet beriberi and dry beriberi, whose prominent symptoms differ.

Riboflavin – (Vitamin B2)

Riboflavin is another B – complex vitamin involved as a coenzyme in the metabolism of carbohydrates, as well as of fats and proteins. The adult RDA for riboflavin has been established at a minimum of 1.2 milligrams per day.

Functions

- It is required by the body to use oxygen and the metabolism of amino acids, fatty acids, and carbohydrates.
- It is used for red blood cell formation, antibody production, cell respiration, and growth.
- It may be helpful in the prevention and treatment of cataracts.

Food sources

Organ meats, nuts, cheese, eggs, milk and lean meat are best sources of riboflavin. It is

also available in good quantities in green leafy vegetables, fish, legumes, whole grains, and yogurt.

Deficiency

A dietary deficiency of riboflavin leads to ariboflavinosis.

Niacin (B3)

Niacin also called nicotinic acid or niacin amide and can be manufactured by body. Niacin is derived from two compounds – nicotinic acid and niacin amide.

Functions

- Niacin functions as a coenzyme in nearly all the metabolic pathways yielding energy from carbohydrates, fats, proteins, and alcohol.
- Niacin also plays a role in tissue respiration.
- It is involved in the synthesis and breakdown of fats, and helps to maintain healthy skin.

Food sources

Liver, lean meat, fish, nuts, cereals, legumes, asparagus, milk, green leafy vegetables and fish. A cup of coffee also provides 3 milligrams of niacin.

Deficiency

A deficiency of niacin is known as pellagra, which means rough skin (from the Italian words pelle for skin and Agra for rough).

Pyridoxine (Vitamin B6)

Pyridoxine is part of the B group vitamins and is water – soluble and is required for both mental and physical health.

Functions

- Pyridoxine is required for the balancing of hormonal changes in women.



- It is essential for the metabolism and proteins, fats and carbohydrates.
- It assists in the maintenance of serum level of sodium and potassium
- It helps to promote red blood cell production.
- It is linked to cancer immunity and fights the formation of the toxic chemical homocysteine.

Food sources

Good sources to obtain pyridoxine are brewer's yeast, egg, chicken, carrot, fish, liver, kidney, pea, wheat germ and walnuts. Roots and tubers, cabbage, legumes, molasses, whole grains, etc., contain moderate amount of this vitamin.

Deficiency

Irritability, nervousness, insomnia, anemia, general weakness, skin changes such as dermatitis.

Folic acid (Vitamin B9) – folic acid, folacin, folate

Folic acid is also referred to as folacin or folate. Its chemical name is pteroylglutamic acid. This vitamin can be produced by the body and be stored in the liver.

Functions

- Folic acid is required for DNA synthesis and cell growth and is important for red blood cell formation, energy production as well as the forming of amino acids.
- Folic acid is essential for synthesizing heme, the iron containing substance in hemoglobin, crucial for oxygen transport.

Folic acid is very important in the development of the nervous system of a developing fetus.

Food sources

Fresh green vegetable such as spinach and broccoli contains folic acid. It is also found in

fruit, starchy vegetables, beans, whole grains, liver, kidney, egg, yeast etc.

Deficiency

A deficiency of folate can lead to macrocytic, megaloblastic anemia, diarrhea, fatigue, depression, and mental confusion.

Cyanocobalamin (Vitamin B12)

Cyanocobalamin also known as cobalamin is referred to as the energy vitamin. It is a very widely researched vitamin, and used in supplementation to a very large degree.

Functions

- Cobalamin is required in the metabolism of fats, proteins and carbohydrates.
- It is needed in the manufacture of red blood cells and the maintenance of red blood cells.
- It stimulates appetite and Promotes growth.

Food sources

Liver, organ meat, muscle meat, shellfish, egg, cheese and fish are rich sources of this vitamin. It can be manufactured in the body. Milk contains vitamin B₁₂ however processing of milk may destroy the vitamin.

Deficiency

Vitamin B12 deficiency results in macrocytic, megaloblastic anemia (pernicious anemia) similar to that occurring with folate deficiency.

Biotin (Vitamin B7)

Biotin is also referred to as anti – egg white injury factor.

Biotin present in foods in not affected by exposure to light. Biotin is also produced by bacteria in the intestine.

Function

- Biotin is involved in carbohydrate and lipid metabolism.

- Biotin is also indicated for healthy hair and skin, healthy sweat glands, nerve tissue, and bone marrow.
- Biotin is also helps in maintaining a steady blood sugar level.

Food sources

Biotin is widely distributed in both animal and plant foods. Liver, kidney, egg, yolk, milk, tomatoes are rich sources.

Deficiency

Dietary deficiency of biotin is rare. Symptoms of biotin deficiency include lack of appetite, nausea, an enlarged tongue, mental depression, pallor, loss of hair.

Pantothenic acid (vitamin B6)

Pantothenic acid referred to as the “anti – stress vitamin” is part of the B group vitamins. This vitamin can be produced in the body by the intestinal flora.

Functions

- Pantothenic acid plays an important role in the secretion of hormones, such as cortisone because of the role it plays in supporting the adrenal gland.
- Pantothenic acid is also used in the release of energy as well as the metabolism of fat, protein and carbohydrates.
- It is used in the synthesis of lipids, neurotransmitters and haemoglobin.

Food sources

Beef, brewer’s yeast, egg, fresh vegetables, kidney, legumes, liver, mushrooms, nuts, pork, royal jelly, saltwater fish, torula yeast, whole rye flour, and whole wheat contain this vitamin.

Deficiency

Symptoms of a pantothenic acid deficiency though rare, may occur in severely malnourished individuals and include fatigue, irritability, low blood pressure upon standing,

lack of appetite, constipation, and tingling and numbness in both the feet and hands.

5.9 Minerals

The essential minerals are classified according to their recommended intake. Macro minerals, also called major minerals, are needed in amounts greater than 100 milligrams per day. Micro minerals, also called trace minerals or trace elements, are needed in less than 100 milligrams per day.

Table: 10 Classification of essential minerals

Macro minerals (> 100 mg/day)*	Micro minerals (<100 mg/day)*
Calcium	Iron
Phosphorus	Zinc
Magnesium	Copper
Sulfur	Iodine
Sodium*	Fluoride
Potassium*	Manganese
Chloride*	Selenium
	Chromium
	Molybdenum

*Recommended intakes are greater or lesser than 100mg per day, as indicated.

Macro minerals

There are seven macro minerals; calcium, phosphorus, magnesium, sulfur, sodium, potassium, and chloride. As well as being needed in amounts greater than 100 milligrams per day, each of the macro minerals makes up more than 0.01% of the body’s weight.

Calcium

Calcium is by far the most prevalent mineral in the body. About 98% of the 1200 grams (2.5 pounds) of calcium in the average adult body is found in the bones. Small amounts of calcium (1%) are also found in the extracellular fluid, certain intracellular structures, and cell membranes.



Function

- Calcium is one of the minerals needed for the growth and strength of the bones.
- Calcium is needed for muscle contraction
- Calcium ions are essential for blood clotting.
- Calcium is needed for the functioning of neuro transmitters.

Food sources

Milk and milk products are among the best sources of calcium, other sources of calcium includes leafy greens, firm tofu, and small fish with bones, such as sardines.

Deficiency

A severe deficiency of calcium leads to the condition hypocalcemia resulting in rickets in children and osteomalacia in adults.

Phosphorus

Approximately 85% of the 700 grams of phosphorus in the adult body is present in the bones. The ratio of calcium to phosphorus in the bones is 2: 1. After calcium, phosphorus is the second most common mineral in the body by weight.

Function

- Phosphorus is involved in a variety of chemical reactions in the body, many of which are related to energy metabolism.
- Mineralization of bones and teeth
- Facilitation of energy transaction
- Absorption and transport of nutrients
- Regulation of protein activity
- Component of essential body compounds.

Food sources

In general, good sources of protein are also good sources of phosphorus. Meat, poultry, fish and eggs are rich in phosphorus. Milk and milk products, nuts, legumes, cereals and grams are good sources.

Deficiency

A phosphorus deficiency is characterized by weakness, lack of appetite, fatigue and muscle pain.

Magnesium

About 60% of the body's magnesium is contained in the bones; most of the remaining magnesium is present in the muscles and other tissues, with about 1% circulating extracellular fluids.

Function

- The activity of hundreds of enzymes depends on magnesium
- Magnesium also helps maintain calcium and potassium homeostasis.

Food sources

Nuts, legumes, dark green leafy vegetables, soya beans and milk are good sources.

Deficiency

Symptoms of magnesium deficiency include weakness, confusion, lack of appetite, nausea, and lack of coordination.

Sulfur

Because sulfur is part of the essential amino acid methionine and the nonessential amino acid cysteine, it is present in the body's proteins. Interactions among sulfur atoms in cysteine helps to give proteins their three dimensional shape.

The Electrolytes

Three of the macrominerals – Sodium, potassium and chloride are the body's main electrolytes. The major function of the electrolytes is to maintain the proper distribution of water inside and outside cells. If this water balance is not maintained, cells will shrink or swell beyond their normal size. Sodium and chloride are found in the extracellular fluid; potassium is found in the intracellular Fluid (ICF).



Sodium

Sodium is the principal cation of extracellular fluid. Human body has approximately 1.8 g of sodium per kilogram of body weight. The body regulates the sodium concentration in the extracellular fluid within narrow limits.

Function

In addition to its role in maintaining the body's water balance, sodium functions in maintaining extracellular fluid volume and in regulating the body's acid – base balance.

Food sources

The major dietary source of sodium is sodium chloride, more commonly called table salt. One teaspoon of table salt supplies 2132 milligrams of sodium.

Deficiency

Excessive sodium loss, not a low dietary intake; is the usual cause of sodium deficiency. Trauma, long – term diarrhea, vomiting and kidney disease may also lead to excessive sodium losses.

A sodium deficiency, with fluid levels remaining constant or increasing, leads to a decrease in the extracellular sodium concentration. As a result, water migrates into cells, leading to water intoxication. Water intoxication causes loss of appetite, muscle twitching, mental apathy, coma, and seizures.

Potassium

The electrolyte potassium is found mainly in the intracellular fluid

Functions

- The main function of potassium, like sodium, is to maintain water balance.
- Potassium is required for maintaining a normal heartbeat.

Food sources

This mineral is widely distributed in foods, but fruits and vegetables are generally the most nutrient – dense sources of potassium.

Deficiency

As with sodium, deficiencies of potassium are usually caused by excessive losses, not low intakes. Losses occur primarily via the urine; lesser amounts are lost in sweat. Excessive potassium losses via the kidneys may result from use of potassium – depleting diuretics, which are often prescribed to treat high blood pressure. High levels of activity in hot, humid climates may lead to excessive potassium losses via perspiration. Much potassium can also be lost through long-term vomiting or prolonged diarrhea.

Symptoms of a potassium deficiency include weakness, loss of appetite, nausea, listlessness, apprehension, fatigue, irrational behavior, muscle weakness, and muscle cramping. A severe deficiency may cause an abnormal heartbeat and possibly death.

Chloride

The electrolyte chloride is found primarily in the extracellular fluid.

Functions

- Chloride's major functions are maintaining the body's water and electrolyte balance.
- Chloride is mainly a component of hydrochloric acid, which is secreted in the stomach and helps in the digestion of protein.

Food sources

The main dietary sources of chloride is sodium chloride, that is, table salt. Chloride is also found in many processed food that contain added salt.



Deficiency

As with the other two electrolytes, chloride deficiency rarely results from poor dietary intake. Rather, chloride deficiencies are typically caused by excessive losses due to diarrhea or vomiting, heavy perspiration, trauma, or kidney disease.

Micro minerals

We require intakes of the essential trace minerals, or micro minerals, in amounts of less than 100 milligrams per day. The essential trace minerals are iron, zinc, copper, iodine, manganese, fluoride, chromium, selenium, and molybdenum.

Iron

About 30% of the iron in the body is stored in the spleen, liver, and bone marrow. Iron is a constituent of haemoglobin and myoglobin, which are iron-binding proteins found in red blood cells and muscle, respectively. Iron also function as a cofactor for a number of enzymes and is required for their activity.

Deficiency

Iron deficiency develops in stages; the last stage is iron-deficiency anemia.

Zinc

Most zinc in the body is found in the bones and muscles. This trace mineral is necessary for optimal activity of many enzymes and for various bodily processes, including the following:

- Protein metabolism, wound healing, and growth
- Metabolism of DNA, the genetic material
- Development of sexual organs and bones
- Immune responses
- Memory formation
- Alcohol metabolism

Particularly high needs for zinc occur during growth and development.

Food sources

Meat, fish, eggs, milk and nuts are rich sources.

Deficiency

A zinc deficiency impairs protein synthesis, collagen formation, and energy production; it also decreases alcohol tolerance.

Copper

The trace mineral copper is required for proper use of iron by the body and for the activity of certain enzymes. This trace mineral also aids in the production of connective tissue, blood vessels, phospholipids, and melanin (a skin pigment).

Food sources

The main dietary sources of copper are shellfish, whole grains, legumes, and nuts.

Deficiency

Symptoms include decreased blood levels of copper, fewer white blood cells, anemia, bone demineralization, deterioration of the nervous system.

Iodine

The micro mineral iodine is a necessary component of two hormones produced by the thyroid gland (thyroxine and triiodothyronine). These thyroid hormones are critical in regulating the body's metabolic rate.

Food sources

The amount of iodine present in a particular food depends on the amount of iodine in the environment in which that food was raised. Therefore, food from the sea lobsters, oysters, sardines etc.



Deficiency

A prolonged deficiency of iodine causes enlargement of the thyroid gland, known as goiter.

Fluoride

Although some scientists have doubted that fluoride is an essential nutrient for humans, this trace mineral is currently considered essential. The main function of fluoride is to harden the bones and teeth.

Food sources

The only good dietary sources of fluoride are fluoridated water, seafood, seaweed, and tea. Some natural water sources are also high in fluoride.

Deficiency

Deficiency of fluoride results in the development of dental caries.

Manganese

The trace mineral manganese is required for normal brain function. This micro mineral also aids in the synthesis of collagen, urea, fatty acids, and cholesterol. Manganese is involved in bone growth and is required for the digestion of protein.

Food sources

Manganese is present in many vegetable foods, and our diets supply plenty to meet the requirement, which is minimal.

Deficiency

For the above reason, deficiency of this trace mineral has not been observed in humans, although it can be induced in experimental animals.

Selenium

The best understood role of the micro mineral selenium is its involvement in an enzyme system that helps to protect cell membranes against oxidative damage. Thus

selenium has an effect similar to that of the antioxidant vitamin E.

Food sources

Selenium is widely distributed in both animals and plant foods.

Deficiency

Deficiency resulting from low dietary intake is unlikely because of its wide distribution in animals and plant foods.

Chromium

The trace mineral chromium is involved in the normal use of glucose and blood lipids and in the functioning of insulin. The active form of chromium in the body is called the Glucose Tolerance Factor (GTF).

Molybdenum

Molybdenum is required for several enzyme systems in the body. One of these enzyme systems involved in the formation of uric acid, a waste product of protein metabolism is excreted in the urine.

Food sources

The molybdenum of plant foods depends on the type of soil in which they are grown. (Neutral or alkaline soil).

Deficiency

Molybdenum deficiency has not been observed in human beings or any other species.

■ Ultra trace mineral

Seven minerals present in foods and in human bodies have been found to be essential nutrients for animals and may be essential for humans, but nutritional requirements for them have not yet been clearly defined. This group of minerals sometimes called ultra-trace minerals, includes arsenic, boron, cobalt, nickel, silicon, tin, and vanadium.

Table 11: Functions and dietary sources of ultra-trace minerals

Mineral	Essential for	Functions	Good dietary sources
Arsenic	Animals possibly humans	Aids normal growth and use of iron; needed for conversion of methionine to cysteine.	Fruits, vegetables, fish, shellfish, grains
Boron	Plants Possibly animals Possibly humans	Affects use of calcium, magnesium and copper and protein metabolism; involved in composition of kidney and brain; may be needed for membrane function; may help prevent loss of calcium from bone in postmenopausal women.	Noncitrus fruits, leafy greens, nuts, legumes, cider, wine, beer.
Cobalt	Animals Possibly humans	Is part of vitamin B ₁₂ , which is necessary for production of normal red blood cells.	Liver and red meat.
Nickel	Chickens, rats, pigs, and goats possibly humans	Involved in iron absorption, use of calcium, zinc, and vitamin B ₁₂ , and metabolism of genetic material (DNA)	Nuts, legumes, whole grains.
Silicon	Animals possibly humans	Probable required for deposition of minerals, especially calcium, in bones; needed for synthesis of collagen and elastin, major proteins in connective tissue.	Whole grains, cereal products, root vegetables (e.g. potatoes, carrots)
Tin	Rates	Is necessary for normal growth	Commercial fats
Vanadium	Experimental animals	Probably involved in iodine and glucose metabolism and thyroid function	Whole grains and grain products; meat, poultry, and fish (moderate levels)

5.10 Therapeutic Diets

Modification of nutrients in therapeutic Diets

The general principles of nutrition related to health apply also to the treatment of patients suffering from various diseases. Diet in disease must be planned as part of the complete care of the patient many modifications may have to be made according to the disease and the condition of the patient, but there are certain general principles which may be used for guidance.

Principle of Therapeutic Diets

1. Carbohydrates are usually well – tolerated and are necessary to maintain the stores of liver glycogen.

2. The tolerance of fats varies in different individuals and this nutrient should not be forced if there is nausea and vomiting.
3. In illness, there is usually an increased demand for proteins, due to wasting and this should be given in easily digestible forms such as milk, egg, chicken and fish.
4. The requirements of calcium and iron must be maintained during illness and it is necessary to check.
5. Fat – soluble vitamins often need to be added as concentrates if a patient has to be on a fat – restricted diet for a long time. The demand for Vitamin C is greatly increased in fevers, and it is especially necessary for the healing of wound after surgery.

6. Roughage: Excessive bulk hinders the penetration of the digestive juice, but it may be necessary to include foods with a moderately high residue content to produce daily bowel action.
7. Fluids are very important to prevent dehydration which is common in conditions of fevers, diarrhea and vomiting. In such condition 2,500 –

3,000 ml must be given in 24 hours with as much variety as possible, both in appearance and in taste.

■ Diabetes mellitus

Diabetes mellitus is a condition in which the secretion of insulin by the islets of Langerhans in the pancreas is deficient or absent. It is characterized by hyperglycemia,

Table 12: Diabetes Mellitus

Vegetarian	Non – vegetarian
Morning	
Tea or coffee (without sugar)	Tea or coffee (without sugar)
Breakfast	
Corn flakes with milk	Corn flakes with milk
Cheese	Boiled egg
Toast with butter	Toast with butter
Tea or coffee	Tea or coffee
Mid – morning	
Tea or coffee (without sugar)	Tea or coffee (without sugar)
Lunch	
Cooked rice or chapatti or bread	Cooked rice or chapatti or bread
Cooked soup	Cooked dal
Vegetable soup	Mutton or fish curry
Pappad	Pappad
Curds	Curds
Roasted groundnut or cashewnut	Roasted groundnut or cashew nut
Fruit (half apple or one slice of papaya or mango)	Fruit (half apple or one slice of papaya or mango)
Tea	
Salt biscuits	Salt biscuits
Roasted nuts	Roasted nuts
Tea or coffee (without sugar)	Tea or coffee (without sugar)
Dinner	
Similar to Lunch	

Table 13: Daily menu for high blood pressure

Vegetarian	Non – vegetarian
Morning	
Weak tea – 1 cup	Weak tea – 1 cup
Breakfast	
Bread or corn flakes with skin milk or idly – 1 serving (with sugar and jam) (without salt)	Bread or corn flakes with skin milk or idly – 1 serving (with sugar and jam) (without salt)
Fruits – 1 serving	Fruits – 1 serving
Weak tea – 1 cup	Weak tea – 1 cup
Mid – morning	
Fruit juice – 1 glass	Fruit juice – 1 glass
Lunch	
Cooked rice or chapatti – 1 serving	Cooked rice or chapatti – 1 serving
Cooked dal – half cup	Meat or fish curry – half
Curds – 2 cups	Curd – 1 cup
Cooked vegetables and potato – 1 serving	Cooked vegetables and potato – 1 serving
Fruits – 1 serving	Fruits – 1 serving
Skimmed milk pudding – 1 cup	Skimmed milk pudding – 1 cup
Evening	
Biscuits – 2	Biscuits – 2
Fruit juice – 1 glass	Fruit juice – 1 glass
Dinner	
Similar to Lunch	

and glycosuria accompanied by polyuria, polydipsia, polyphagia, and if untreated for a long time by loss of weight.

Hypertension

Hypertension develops due to some reason, there is increased resistance to the normal circulation of blood. This may be temporary, as the result of exercise, pregnancy, or menopause; it may be permanent, associated with atherosclerosis, cardiac failure or chronic kidney disease.

Notes

1. Salt should not be added in cooking
2. One multivitamin tablet providing the daily requirements of all essential vitamins should be included along with the diet
3. Strong coffee is not permitted.

Table 14: Daily menu for Hypertension

Food stuffs	Vegetarian	Non - vegetarian
Milled cereals	200	200
Skin mil (fluid)	1000	1000
Pulses	60	40
Cheese	60	20
Meat or fish	-	20
Leafy vegetables	100	100
Other vegetables	100	100
Fruits	300	300
Vegetable oils (sesame or safflower or sunflower seed oil)	60	60
Sugar and jam	40	40

Coronary Heart Diseases

A majority of coronary heart diseases are due to coronary antheroma (A fatty deposit in the inner lining of an artery) and atherosclerosis, are used to denote conditions in which lipid is deposited in the intima of the blood vessels.

Calories – 1800 – 2000 Kcal; Fat (rich in essential fatty acids) – 60 gm; Proteins – 50 – 60 gm

Note: one multivitamin tablet providing the daily requirements of all essential vitamins should be given daily.

Table 15: Daily menu for coronary heart disease

Vegetarian	Non - vegetarian
Morning	
Weak tea	Weak tea
Breakfast	
Corn flakes with skimmed milk or bread of idly – 1 serving Cheese – 2 slices Fruits – 1 serving Weak tea – 1 cup	Corn flakes with skimmed milk or bread or idly – 1 serving Cheese – 2 slice Fruits – 1 serving Weak tea – 1 cup
Lunch	
Cooked rice or chapatti – 1 serving Dal soup – 1 cup Cooked vegetables – 1 serving Cheese – 2 slices Curds – 2 cups Fruits – 1 serving Skimmed milk pudding – half cup	Cooked rice or chapatti – 1 serving Mutton soup – 1 cup Mutton or fish curry – 1 serving Curds – 1 cup Fruits – 1 serving Skimmed milk pudding – half cup
Tea	
Biscuits – 2 Fruits – 1 serving Weak tea – 1 cup	Biscuits – 2 Fruits – 1 serving Weak tea – 1 cup
Dinner	
Similar to Lunch	

Chronic Renal Failure

Chronic Renal Failure occurs in glomerulonephritis, and chronic pyelonephritis. In this condition, the glomeruli and tubules are heavily damaged.

Diet

The diet in chronic uraemia (presence of abnormal of uric acid salts in the blood) should be below in protein depending on the urea content of blood. The pattern of diet and the daily menu for an adult suffering from chronic renal failure are given in Tables 16 and 17.

Table: 16 Diet for an adult suffering from chronic renal failure

(Calories 1500 – 2000 Kcal; Proteins 15 – 20 gm; Fat 40 – 50 gm, Carbohydrates 300 – 40 gm; Salt free)

Foodstuffs	gm/caput/day
Cereals	200
Vegetables (potato, carrot)	100
Milk	200
Egg	30
Butter and vegetable fats	40 – 50
Sugar	50
Glucose	200
Fruit juice	1000 ml

Table 17: Daily menu for chronic renal failure

Morning	Fruit juice with glucose – 1 glass
Breakfast	Bread – 2 slice Butter – 2 teaspoons Jam – 2 teaspoons Fruit juice with glucose – 1 glass
Lunch	Cooked rice or bread – 1 serving Butter or ghee – 2 teaspoons Potato and carrot curry – 1 serving Curds – 1cup Fruit juice with glucose – 1 glass
Tea	Biscuits – 3 Butter – 1 teaspoon Fruit juice with glucose – 1 glass
Dinner	Similar to Lunch

Note: Common salt should not be added during or after cooking. One multivitamin tablet providing the daily requirements should be taken

Peptic Ulcer

Chronic ulcer formed in the region of the gastrointestinal tract where the gastric juice comes in direct contact with the mucous membrane is known as peptic ulcer. Such ulcers usually occur in the duodenum (duodenal ulcer) and in the stomach (gastric ulcer). Duodenal ulcer is associated with hyperacidity while gastric ulcer is not.

Diet in Peptic Ulcer

The diet is the most important factor in the treatment of peptic ulcer. Three main types of diets have been used in the treatment of peptic ulcer.

Table 18: Types of therapeutic diet for peptic ulcer

Name of Diet	Ingredients
Sippy's diet and its modification by Hurst	Hourly feeds of milk, cream and olive oil with antacid medication
Lenhartz diet	Fluid diet based on milk and eggs
Meulengracht diet	A mixed bland diet containing milk, egg, meat and fish (Minced and strained) given once in 2 hours.

Sippy's diet consisting of milk and olive oil was used widely. Since it is monotonous and not adequate to meet the calorie needs, it has been replaced by a bland diet containing large quantities of milk.

Table 19: Diet for adult suffering from peptic ulcer (gm/caput/day)

Foodstuffs	Vegetarian	Non – vegetarian
Milled rice and refined wheat flour, or bread and biscuit	200	200

Dal (decuticled split legumes)	50	50
Milk	1800	1500
Cheese	50	-
Eggs	-	30
Meat or lean fish	-	60
Fats and oils (2/3 as vegetable oils rich in essential fatty acids)	60	60
Sugar	60	60
Tender vegetables	50	50
Potato	50	50
Fleshy fruits (banana, apple and mango)	100	100

Note: One vitamin C tablet (100mg) may be taken once daily.

Table 20

Vegetarian	Non - vegetarian
Morning 6 am	
Milk – 2 cups (with 2 teaspoon sugar)	Milk – 2 cups (with 2 teaspoon sugar)
Breakfast 8 am	
Breads – 2 slices Butter – 2 teaspoons Cheese – 2 slices Milk – 1 cup	Breads – 2 slices Butter – 2 teaspoons Boiled egg – one Milk – 1 cup
10 am	
Milk – 2 cups (with sugar)	Milk – 2 cups (with sugar)
12 noon (Lunch)	
Cooked rice or bread – 1 serving Smashed dal – 1 cup Cheese – 2 slices Boiled potato – 2 Milk pudding – 1 cup	Cooked rice or bread – 1 serving Smashed dal – 1 cup Cooked minced meat – 1 serving Boiled potato – two Milk pudding – 1 cup

2 pm	
Milk – 1 cup	Milk – 1 cup
4 pm	
Biscuits – 2 Milk (with sugar) – 1 cup	Biscuits – 2 Milk (with sugar) – 1 cup
6 pm	
Milk (with sugar) – 2 cups	Milk (with sugar) – 2 cups
8 pm (Dinner)	
Same as Lunch	Same as Lunch
10 pm	
Milk – 1 cup	Milk – 1 cup

Table 21: Foods permitted and not permitted in peptic ulcer

Permitted	Not permitted
1. Milled cereals (milled rice, refined wheat flour and semolina)	1. Whole cereals and whole millets
2. Dal (decuticled split legumes)	2. Legumes with husk (Bengal gram, field bean, cow gram, dried pea, etc.).
3. Milk	3. Vegetables containing fiber, raw onions, garlic, etc.
4. Eggs	4. Spices and condiments and pickles
5. Tender vegetables free from fiber	5. Meat soups and extractives
6. Meat and fish in limited amounts	6. Fried foods
7. Fruits without fiber	7. Alcohol and alcoholic drinks
8. Fats and oils	8. Chewing betel leaves, arecanut and tobacco
9. Sugar	

5.11 Adulteration of Food Additives

Food additives are defined as non-nutritious substances which are added intentionally to food generally in small



quantity, to improve its appearance, flavor, texture or storage properties.

Food additives may be classified into two categories. Additives of the first category includes:

- Coloring agents, e.g. saffron, turmeric
- Flavoring agents, e.g. vanilla essence
- Sweeteners, e.g. saccharin
- Preservatives, e.g. ascorbic acid, sodium benzoate
- Acidity imparting agents, e.g. citric acid, acetic acid, etc.

These agents are generally considered safe for human consumption. Additives of the “Second category” are, strictly speaking, contaminants incidental through packing, processing steps, farming practices (insecticides) or other environmental conditions.

Uncontrolled or indiscriminate use of food additives may pose health hazards among consumers. For example, certain preservatives such as nitrites and nitrates can lead to the production of toxic substance, e.g. nitrosamines that have been implicated in cancer etiology.

Food Fortification

Fortification of food is a public health measure aimed at reinforcing the usual dietary intake of nutrients with additional supplies to prevent / control some nutritional disorders.

WHO has defined “Food fortification” as the process whereby nutrients are added to foods (in relatively small quantities) to maintain or improve the quality of the diet of a group, a community or a population.” For example,

1. Foods artificially fortified with vitamin ‘D’ e.g. milk, margarine, Vanaspati and infant foods.
2. Foods fortified with vitamin ‘A’ e.g. margarine, milk, Vanaspati.

Adulteration of Food

Adulteration of food is an age – old problem. It is done through a large number of practices:



- Mixing
- Substitution
- Abstraction
- Concealing the quality
- Putting up decomposed foods for sale
- Misbranding or
- Giving false labels and
- Addition of toxicants.

Food adulteration practices vary from one part of the country to another, and from time to time.

The types of adulteration commonly found in India are as follows:

1. **Milk:** Addition of water, removal of fat and addition of starch to make the milk thicker are the common forms of milk adulteration.
2. **Ghee:** This is adulterated with dalda and animal fats such as pig’s fat.
3. **Rice and wheat:** These are mixed with stone chips and mud to increase the bulk
4. **Flour:** Wheat flour is mixed with soap stone powder and cheaper flours such as singhada flour.
5. **Pulses:** Chemical substances are added to old stocks to improve the appearance.
6. **Tea and coffee:** Tea leaves are adulterated with old tea leaves; leather and saw dust, coffee is adulterated with chicory
7. **Honey:** This is adulterated with sugar or jaggery and boiled with empty beehives.
8. **Medicines:** Even drugs are adulterated.

The prevention of Food Adulteration Act 1954

Any food that does not conform to the minimum standards is said to adulterated standards. Provisions have been laid down under this Act for various foods.

In 1954, the Government of India enacted a Central Prevention of Food Adulteration Act. The act has been amended several times, the latest amendment is that of 1976 and in lately in 1986 to make the Act more stringent.

Although it is a Central Act, its implementation is largely carried out by the local bodies and State Governments.

■ Food Standards

FAO/WHO formulates food standards for international market. Codex Alimentarius commission which is the principal organ of the joint FAO/WHO food standards programme. The standards in India are based on the standards of the Codex Alimentarius.

■ PFA Standards

Under the Prevention of Food Adulteration Act, 1954 standards have been

established which are revised from time to time by the “Central Committee for Food standards”.

The purpose of PFA standards is to obtain a minimum level of quality of foodstuffs attainable under India conditions.

■ The Agmark Standards

These standards are set by the Directorate of Marketing and Inspection of the Government of India.

■ Bureau of India Standards

The ISI mark on any article of food is a guarantee of food quality in accordance with the standards prescribed by the Bureau of Indian Standards (BIS) for that commodity.

SUMMARY

- ❖ Nutrition is the science of food and its relationship to health. It is concerned with the part played by nutrients in body growth, development and maintenance.
- ❖ Good nutrition is essential for attainment of normal growth and development during fetal life and childhood. Physical growth, intellectual development, learning and behavior are affected by malnutrition.
- ❖ Adequate nutrition is needed for adult life maintenance for optimum health and efficiency.
- ❖ Carbohydrates are the main source of energy for daily activities. Carbohydrates (primarily starches) are the least expensive, the most plentifully available, easily obtainable and readily digested form of nutrient.
- ❖ The lipids are a heterogeneous group of substances found in plant and animal tissues, which share the property of being relatively insoluble in water, and soluble in organic solvents, such as ether, chloroform and benzene.
- ❖ Proteins are polymer chains made of amino acids linked together by peptide bonds. Amino acids can be divided into essential amino acids and non – essential amino acids. Proteins and carbohydrates contain 4 kcal per gram as opposed to lipids which contain 9 kcal per gram of energy.
- ❖ Vitamins are essential organic, compounds that are needed in small amounts in the diet both to prevent deficiency diseases and to support optimal health. The term vitamin (vital amines) was coined by Casmir Funk. The term vital denoting essential for life and amines because these compounds contained an amine functional group.
- ❖ The four fat – soluble vitamins – vitamins A, D, E and K are often present in the fat portion of foods, they are not easily lost from foods or destroyed by exposure to water, heat, air, or light.

- ❖ The water soluble vitamins include vitamin C and B complex vitamins – thiamine, riboflavin, niacin, pyridoxine, folate, cyanocobalamin, biotin and pantothenic acid. Most of these are unstable and thus easily destroyed by exposure to water, heat, air or light.
- ❖ WHO has defined “Food fortification” as the process whereby nutrients are added to foods (in relatively small quantities) to maintain or improve the quality of the diet of a group, a community or a population.

GLOSSARY

A-Z

1.	Assimilates	- தன்மயமாக்கு	To absorb into the system / absorb
2.	Organic	- கரிம	Derived from living matter
3.	Inorganic	- கனிம	Not derived from living matter
4.	Resistance	- எதிர்ப்பு	The refusal to accept
5.	Metabolism	- வளர்சிதை மாற்றம்	The chemical processes that occur within a living organism in order to maintain life
6.	Heteragenous	- பலவகைப்பட்ட	Diverse in character / content
7.	Steroid	- ஊக்க மருந்து	Type of chemical substance artificially introduced to improve strength
8.	Bruising	- சிராய்ப்பு	a brown or purple mark on your skin
9.	Sedantary work	- உடல் உழைப்பு தேவைப்படாத	very limited amount of physical activity
10.	Pigment	- நிறமி	The natural colouring matter
11.	Flaking	- செதில் செதிலாக	To come off a surface in small, thin pieces
12.	Degenarating	- கொஞ்சம் கொஞ்சமாக சீரழிந்த	decline / to fall below a normal
13.	enzyme	- நொதிகள்	proteins that speeds up the rate of a chemical reaction in a living oraganism
14.	Goiter	- முன்கழுத்துக் கழலை நோய்	abnormal enlargement of thyroid gland result from under or over production of hormone due to deficiency of iodine
15.	Fortification	- வலுவூட்டல் / ஊட்டமேற்றுதல்	addition of nutrients to foods irrespective of whether or not the nutrients were orginally present in the food
16.	Adulteration	- கலப்படம்	The act of making food by adding something to them
17.	Additives	- சேர்க்கைப் பொருட்கள்	
18.	Anabolism	- வளர்சிதை மாற்றம்	In living organisms synthesis of more complex substances from simpler ones
19.	Lactation	- பாலூட்டும்	The action of sucking of milk by an infant
20.	Pastries	- மாவுப்பண்டம்/கேக்	a mixture of flour, fat and water which is used as base or covering for other foods baked



Evaluation

I. Choose the best answer.

1. Proteins, Carbohydrates and fats are e.g. of
 - a) Micro Nutrients
 - b) Macro Nutrients
 - c) Protective food
 - d) Diets
2. Pick the odd one out classification of nutrients is based on
 - a) Body building
 - b) Energy giver
 - c) Protective food
 - d) Healthy food
3. Find the water soluble vitamin
 - a) Vitamin A
 - b) Vitamin B
 - c) Vitamin C
 - d) Vitamin D
4. This Vitamin plays the role in the synthesis of rhodopsin.
 - a) Vitamin B
 - b) Vitamin A
 - c) Vitamin D
 - d) Vitamin K
5. Varicose vein inflammation occurs due to deficiency of the following Vitamin
 - a) Vitamin K
 - b) Vitamin E
 - c) Vitamin D
 - d) Vitamin B
6. Which Vitamin is responsible for nervous system development of a fetus
 - a) Folic acid
 - b) Niacine
 - c) Pyridoxine
 - d) Cyanocobalamin
7. Each gram of carbohydrates yield _____ of energy.
 - a) 2k cal
 - b) 4k cal
 - c) 6k cal
 - d) 8k cal
8. Carbohydrates is stored in animals in the form of
 - a) Starch
 - b) Glycogen
 - c) Malt sugar
 - d) Disaccharide
9. 1g of fat provide _____ KJ of energy.
 - a) 40
 - b) 50
 - c) 35
 - d) 37

10. Anti stress vitamin is _____.

- a) Pantothenic acid
- b) Biotin
- c) Miacin
- d) Cyanocobalamin



II. Short Answer.

11. Brief on Malnutrition.
12. Define Hypertension
13. Tabulates the food permitted and to be avoided in peptic ulcer.
14. Give two examples of flavouring agents.
15. What is "food fortification"?
16. What are the functions of vitamins?
17. Note on Calciferol.
18. Note on Vitamin B₁.
19. What are the food sources rich in Vitamin B₆?

III. Brief Answers.

20. What are the factors affecting food and nutrition?
21. What are the major food groups given by ICMR?
22. Note on functions of Carbohydrate.
23. What is glycolysis?
24. What are the functions of Riboflavin?
25. Brief on Micro minerals.
26. What are the uses of zinc in our body?
27. Tabulate the functions of Boron, Cobalt, Nickel and Silicon.

IV. Detail answer.

28. Give a brief note on fat and its classification.
29. Give a menu plan for diabetes mellitus.
30. Write in detail on any four major mineral sources.
31. Brief on adulteration.



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INTERNET LINKS

1. seafood.ucdavis.edu/sanitation/Ch5points.rtf
2. www.fda.gov/oc/history/historyoffda/default.htm - 8k
3. www.itrcindia.org/services2.html - 13k
4. <http://www.perstorp.se/pnet/ext/septp370.nsf/EnvRep/>
5. <http://people.cornellcollege.edu/cliberko/OrgLabManual>



ICT CORNER

APPLIED NUTRITION

Through this game activity you will be able to differentiate the food varieties based on their nutritional classification.



Steps

- **Step 1:**
- **Step 2:** Click the START button to start the game activity.
- **Step 3:** A page with pictures of food varieties are arranged as a grid of picture tiles will open.
- **Step 4:** Drag and drop the tiles into the buckets give below to sort. Continue the activity as per the instructions displayed during the game and complete the game.

URL : <https://www.brainpop.com/games/sortifynutrition/>

*Pictures are indicative only



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