**FOOD AND NUTRITION**

**Short and Essay questions Unit I, Unit II and part of Unit III.**

1. **Nutrition** as defined by Robinson (1982) is “ the science of foods and nutrients, their action, interaction and balance in relationship to health and disease, the processes by which the organism ingests, digests, absorbs, transports and utilizes nutrients and disposes of their end product”.
2. **Health** The widely accepted definition of health is that given by the world Health Organization (1948). It defines it as *“a state of complete physical, mental and social well being and not merely an absence of disease or infirmity”*. In recent years, this statement has been amplified to include the ability to lead a *“socially and economically productive life”*.

***3. Cereals:*** *the main carbohydrate rich cereals are Rice, Wheat, Maize, Bajra, Jowar, Oats, Barley, Rye and Finger Millets****.***

**4. My plates** – Eats a variety of foods and eat less of some foods and more of others. The main message is that fruits and vegetables take up half the plate, with the vegetable portion being a little bigger than the fruit section. The plate has been divided so that the grain section is bigger than the protein section. Because nutrition experts recommend you eat more vegetables than fruits and more grains than protein foods.

**5. Classification of carbohydrates**: Carbohydrates are classified, depending on the number of sugar units they contain, as simple carbohydrate and complex carbohydrates. Monosaccharide’s and disaccharides make up simple carbohydrates, called simple sugars containing one and two sugar units respectively. Polysaccharides called complex carbohydrates are structurally larger and more complex than simple sugars. They include starch, dietary fiber and glycogen.

**6. Essential fatty acids: Certain** fatty acids should be provided essentially in the diets, as they are not synthesized in the body. These are polyunsaturated fatty acids, namely linoleic, linolenic and archidonic acids and are grouped as “essential” fatty acids.

**7. ICMR food groups**: ICMR (1989) has classified the different food items into five food groups, as follow: Cereal, roots and tubers, 2. Pulses, nuts and oilseeds, 3. Milk, meat and their products, 4. Fruits and vegetables and 5. Fat and oils, sugar and jiggery.

***8. Balanced diet*:** A balanced diet may be defined as one which contains the various groups of foodstuffs such as energy yielding foods, body building foods and protective foods in the correct portions so that an individual is assured of obtaining the minimum requirements of all the nutrients.

**9. Malnutrition**: Malnutrition refers to deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization. The double burden of malnutrition consists of both under nutrition and overweight and obesity, as well as diet-related non-communicable diseases.

**10. Essential amino acids** are isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. In addition to these infants require histidine for growth.

***11. Water soluble vitamins****-* **There are eight types of vitamin B:** thiamin (B1), riboflavin (B2), niacin (B3), Pantothenic acid (B5), Pyridoxine (B6), Biotin (B7), folate or folic acid (B9) and Cyanocobalamin (B12) and vitamin C.

**12. The Recommended dietary allowance**: The recommended dietary allowance (RDA) is the guideline stating the amount of nutrients to be actually consumed in order to meet the requirements of the body. The RDA is based on requirements. The requirement for a particular nutrient is the minimum level that needs to be consumed to perform specific functions in the body and to prevent deficiency symptoms.

**13. Pluses:** Pulses are green gram, black gram, Bengal gram, red gram, cow pea chick pea beans, etc. Nuts and oil seeds like groundnuts, sesame is included in this group. The foodstuffs from this food group provide major portion of protein for vegetarians as pulses are very good source of proteins. The proteins from these sources are also second-class proteins.

**14. Dietary fiber:** Dietary fiber is defined as that portion of plant material ingested in the diet that is resistant to digestion by gastro intestinal secretions. It consists of hemicelluloses, cellulose, lignin’s, oligosaccharides, pectin’s, gums and waxes.

**15. Functions of Vitamin D**: Vitamin D regulates the absorption of calcium and phosphorus from the intestinal tract and also calcification of bones and teeth. Vitamin D is required for normal bone and teeth development. Vitamin D regulates the enzyme ‘alkaline phosphates’ which regulates the release of phosphate organic compounds.

**16. Functions of Vitamin K**: Vitamin K is essential for the formation of prothrombin and other blood clotting proteins by the liver. Vitamin K probably also participates in oxidative phosphorylation in the tissues.

17. **Vitamin B6**: Vitamin B6 in the form of pyridoxal phosphate functions as a co-enzyme in many biological reactions. Pyridoxine is essential for the process of Transamination , Deamination, Decarboxylation. Vitamin B6 is involved in several biochemical steps for the conversion of the amino acid tryptophan to niacin. It is water soluble vitamin.

18. **Functions of Vitamin B12**: Vitamin B12 is necessary for normal growth and maintenance of healthy nervous tissue and normal blood formation. Involved in DNA synthesis and thus in cell replication. Vitamin B12 co-enzymes are essential for the formation of red blood cells. Vitamin B12 is also required for the synthesis of myelin sheath that surrounds the nerve fiber.

19. **Classification of fatty acids**: There are four major types of dietary fats in foods: saturated fats, trans fats, monounsaturated fats and polyunsaturated fats.   
(1) Saturated fatty acid- these types of fatty acids are without double bonds.  
Example-Stearic acid.  
(2) Monounsaturated fatty acids:-these types of fatty acids are with one double bond.  
Example- Oleic acid.  
(3) Polyunsaturated fatty acids:- these types of fatty acids are with more than one double bond.  
Example- Linoleic acid.

**Folic acid**; Folate (vitamin B-9) is important in red blood cell formation and for healthy cell growth and function. The nutrient is crucial during early pregnancy to reduce the risk of birth defects of the brain and spine.

**UNIT – I:**

The different groups of foods may be broadly classified under three heads from the nutritional point of view.

**1. Energy Yielding Foods:** This group includes foods rich in carbohydrates and fats and also pure fats and carbohydrates. Cereals, roots and tubers, dry fruits sugar and fats are the important energy yielding foods.

**2. Body Building Foods:** Foods rich in [**proteins**](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113399)**a**re called body building foods. This may be broadly divided in to two groups.

Milk, Egg, Meat and Fish rich in [proteins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113399) of high biological value and

Pulses, Oil Seeds and Nuts and low-[fat](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113400) oilseed flours rich in [proteins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113399) of medium nutritive value.

3**. Protective Foods:** Foods rich in [proteins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113399), [vitamins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113405) and [minerals](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113401) are termed protective foods. Protective foods are broadly classified in to two groups.

Foods rich in [vitamins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113405), [minerals](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113401) and [proteins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113399) of high biological value.  
**E.g.** Milk, eggs, fish and liver and

Foods rich in certain [vitamins](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113405) and [minerals](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=113401) only.  
**E.g.** Green leafy and other vegetables and some fruits.

F**unctions of food**

Food may be classified according to their functions in the body

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| --- | --- | --- |
| Physiological | Social | Psychological |
| functions | functions | functions |



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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy yielding | Body building foods | Protective foods | |  |
| (Carbohydrate, Fats | (Protein) | (Vitamins and minerals | |  |
| protein, fat) |  |  | |  |
|  |  | |  |

The functions of food can be broadly classified into three main categories.

1) Physiological functions of food.

2) Psychological functions of food.

3) Social function of food.

**1 )**      **Physiological functions of food**

           The physiological functions of food can be further sub-divided as follow:

a. Energy giving.

b. Body building.

c. Regulatory and protecting functions of food.

**Elaborate the various functions of food?**

a)  **Energy giving:**  Foods rich in carbohydrates and fats are called energy yielding foods. The body needs a constant supply of energy to carry out the involuntary processes like, respiration, circulation of blood etc. which are essential for continuance of life. Energy is also required to carry out voluntary activities like professional, household, and recreational activities. Energy is mainly provided to our body through carbohydrates and fats in the food. Rich sources of carbohydrates are cereals, sugar, jiggery, potatoes, honey etc. Good Sources of fats include ghee, oil, nuts etc. A major part of our daily diet is constituted by these energy-rich food materials.

 b)   **Body Building:**  Foods rich in protein are called body building foods. Thus, one of the most important functions of food is that of building the body. In adult life, the food eaten each day helps to maintain the structure of the adult body, and to replace worn out cells of the body.  Building of new tissues is very important particularly for the growing children and pregnant women. There is also a continuous breakdown of old tissues and building up of new tissues going on in our body at all ages irrespective of the apparent growth, thus maintaining a need for body building nutrients.

For the body building purposes, the major nutrients utilized are proteins and minerals. Proteins are mainly provided through milk and milk products, meat, fish, poultry, nuts, soybean, and pulses etc.

c) **Regulatory and Protective function:**  Foods rich in protein, minerals and vitamins are known as protective and Regulatory foods. The third physiological function of food is to regulate the activities of the body. It includes regulation of such varied activities as beating of the heart, maintenance of body temperature, muscle contraction, control of water balance, clotting of blood, removal of waste products from the body etc. Apart from regulating our body processes, food also protects us from various infections, diseases, and injuries. The main nutrients which perform these functions include proteins, vitamins, minerals, water, and roughage. The major sources of these protective and regulatory nutrients are green leafy vegetable, milk, fresh fruits and vegetable, fish etc.

**B)**  **The Psychological Functions of food**

  The second major function of food is the psychological function. Food must also satisfy certain emotional needs. These include sense of security, love, and attention. Everyone grows in a particular culture with its own unique food habits of that culture and caste.   The person begins to associate the food habits and foods commonly consumed by him, as it gives him a sense of security and satiety. The foods daily eaten by us, give us more mental satisfaction.  In a friendly gathering, one may try unfamiliar foods and thus enlarge our food experiences

**C)**  **Social function of Food**

  Food and eating has significant social meaning. Share food with any other person implies social acceptance. When you share a meal with anyone else, you are expressing your acceptance of friendship and respect for that person. Food is a medium through which we express our happiness. Sweets are also distributed and exchanged to mark certain auspicious occasion like festivals. Food is the common link in a meeting, party or get-together that attracts people to come to such social gatherings.

**2. ICMR FOOD GROUPS**

To get maximum benefit from food, so that it performs all its functions it is important that we take a diet containing all the nutrients in adequate amounts. It is often seen that most foodstuffs contain some nutrients in either more or lesser amounts than required. Thus, to be able to obtain all the nutrients and in adequate amounts, it is important to include different types of foodstuffs in our diet. On the other hand, it is also not possible to include, all the foodstuffs in our diet at one time. Therefore, to overcome this problem, food items providing same types of nutrients have been grouped together, termed as a ‘Food Group’.

Food groups have been formed according to various methods from time to time. ICMR (1989) has classified the different foods items into five food groups, as follow:

1.  Cereal, roots and tubers

2.  Pulses, nuts, and oil seeds

3.  Milk, meat and their products

4.  Fruits and vegetables

5. Fat and oils, sugar and jiggery

 In this classification, the foodstuffs providing similar nutrients have been grouped together.

**1)**  **Cereals, Roots, and Tubers**

This group has been further subdivided into two:

i)  ***Cereals and Cereals products:*** The foodstuffs included in this group are rice, jawar, bajara, maize, bread, etc. These food items are rich sources of energy and, thus provide energy to the body. Cereals are an integral part of our diet on some form or other. Cereals are the cheapest source of energy. In addition to carbohydrates, they also contain some amounts of proteins and as cereals constitute a major part of our daily diet, ample amounts of proteins are derived from them. Cereals are also a good source of B-group vitamins, provided one consumes whole grain cereals, as most of B-group vitamins are present in the outer layer of the cereals.

***(ii)***  ***Starchy roots and tubers:*** Like potatoes, sweet potatoes, jam, colocasia, tapioca etc. mainly provide carbohydrates and are thus grouped along with cereals under energy giving foods. These roots and tubers, can however, be used along with cereals in providing energy.

**2)**  **Pulses, Nuts and Oil seeds**

This food groups include various pulses and legumes, like green gram, black gram beans, etc. Nuts and oil seeds like groundnuts, sesame is included in this group. The foodstuffs from this food group provide major portion of protein for vegetarians as pulses are very good source of proteins. The proteins from these sources are also second-class proteins.

Apart from proteins, nuts also contain a high amount of fat; therefore they are good sources of energy also. Oil seeds like groundnuts, till, mustard, and sunflower seeds etc. also have good amounts of proteins. The oil cake or meal left after the extraction of oils is rather a very good source of proteins.

**3)** **Milk, Meat and their products**

The foodstuffs included in this food groups are:

i)   Milk and milk products. ii)  Eggs, meat fish, poultry etc.

All these foodstuffs provide us with first class proteins i.e. their protein contain all the essential amino acids, in adequate amounts. The food items from this group thus help in body building and maintenance processes.

i)  ***Milk and its products:*** Milk and its products like cheese, curds, are very good source of good quality proteins. Along with proteins milk also provides us with calcium and phosphorous, vitamin A and riboflavin. Milk is a very important food for growing children, as it provides them with good quality proteins, and they are also able to digest it. For small infants this is the only food, which is easily digested and assimilated in the body.

ii) ***Eggs, meat, fish, and chicken:*** These are also excellent sources of first-class protein, which can be totally utilized in our body for building the body. They also contain B-group vitamins in good amounts. Among, this liver is very good source of vitamin A and vitamin B12. Eggs contain nearly all the nutrients, but are particularly good source of protein, fats, vitamin A, iron, Calcium, and phosphorus.

**4)** **Fruits and Vegetables**

This food includes fresh vegetables and fruits which provide protective nutrients to our body i.e. vitamins and minerals. The foodstuffs included in this group are spinach, methi, cabbage, cauliflower, carrot, papaya, mango, apple, tomato, lemon, orange, guava, amla etc.

Green leafy vegetables and orange and yellow colored fruits and vegetables provide us mainly with carotenes. Vitamin C is found in citrus fresh fruits. Vitamin B group is also present in green leafy vegetables. Some fruits like peaches, pineapple and vegetables like fenugreek, mustard leaves, horse gram leaves are exceptionally good sources of iron. Calcium is basically furnished by green leafy vegetables.

Fruits and vegetables also provide dietary fiber to our meals. The fibrous tissues, which are not digested, help to move the food through the digestive tract and regulate excretion of body wastes.

**5)** **Fats and Oils, Sugar and Jiggery** Fats and oils like vegetables oils; hydrogenated fats and pure ghee are very concentrated sources of energy providing 9 Kcal./g. They are mainly used as the cooking medium and hence do form a necessary part of the diet. Fats and oils help to increase the palatability of our food.

Sugar, jiggery and honey supplies energy in the form of carbohydrates. These food items provide about 4 Kcal/g. Sugar is the main source of energy in the form of carbohydrate. Apart, from providing carbohydrates, jiggery is also a good source of iron.

3. **Food pyramid and My plate**

The food guide pyramid was introduced in 1992 by USDA (United States Department of Agriculture) as a general plan of what to eat each day. The food guide pyramid is a valuable tool for planning a health promoting diet.

By incorporating the principle of balance, variety and moderation, an individual can still eat their favorite foods while following the food guide pyramid.

Bread, Grain, Cereal and pasta from the base

At the base of the food pyramid is the group that contains breads, grains, cereals and pastas. These foods provide complex carbohydrates, which are an important source of energy. 6 to 11 servings of these foods in a day. One serving of this group can be

1 slice of bread2. ½ cup of rice, cooked cereal or pasta3. 1 cup of ready to eat cereal 4. 1 flat tortilla

Fruits and vegetables: fruits and vegetables are rich in nutrients. Many are excellent sources of vitamin A, vitamin c, potassium. They are low in fat and sodium and high in fiber. The food pyramid suggests 3 to 5 servings of vegetables each day. One serving of vegetables can be 1 cup of raw leafy vegetables, ½ cup of other vegetables, cooked or raw, ¾ cup of vegetable juice.

The food pyramid suggests 2 to 4 servings of fruits each day. One serving of fruit can be one medium apple, orange or banana, ½ cup of chopped, cooked fruit, ¾ cup of fruit juice.

Beans, eggs, Lean Meat and Fish: Meat, poultry and fish supply protein, iron, and zinc. Non-meat foods such as dried peas and beans also provide many of these nutrients. The food pyramid suggests 2 to 3 servings of cooked meat, fish or poultry. Each serving should be between 2 and 3 ounces. The following foods count as one ounce of meat:

One egg, ½ cup cooked dry beans, 2 tablespoons of peanut butter,

1/3 cup of nuts

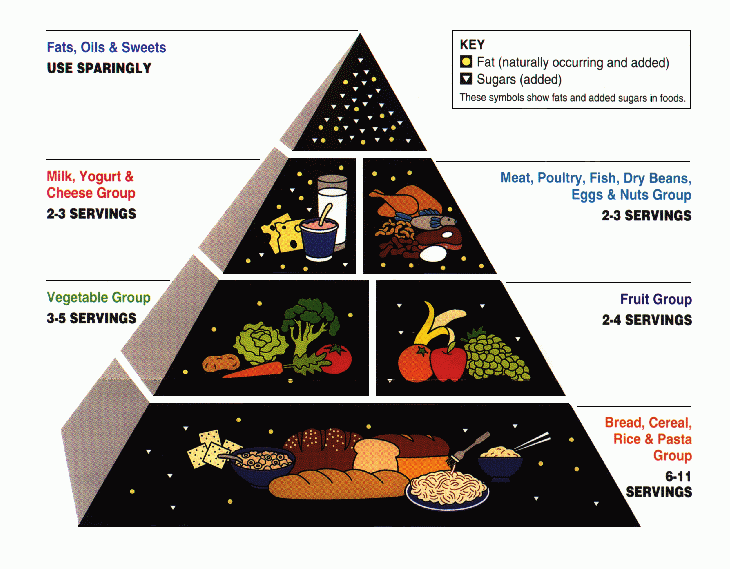
Dairy Products: Products made with milk provide protein and vitamins and minerals, especially calcium. The food pyramid suggests 2 to 3 servings each day. 1 cup of milk, 1 ½ ounce of natural cheese, 1 ounce of process cheese.

Fats and sweets: A food pyramids tip is the smallest part, so the fats and sweets in the top of the food pyramid should comprise the smallest percentage of your daily diet. The foods at the top of the food pyramid should be eaten sparingly because they provide calories but not much in the way of nutrition. These foods include salad dressings, oils, cream, butter, margarine, sugars, soft drinks, candies and sweet desserts. The food guide pyramid can be extremely useful – whether you want to gain weight, lose weight or maintain your weight. Eating healthy diet simpler easier if you base your choices on the food pyramid.

The new food pyramid become three dimensional and has a figure climbing up the side of it, the horizontal lines have been replaced by vertical lines starting from the tip of the pyramid and radiating downward. The new food pyramid is color coded. The six colored stripes denote the quantities of food you should consume. An orange stripe represents grains, a green stripe for vegetables, a red stripe for fruits, yellow stripe denotes how much fats and oils should have, a blue stripe for the milk and dairy products that your allowed, and a purple stripe shows the quantities if meat, fish, beans and pulses that you should eat in a day. Today the food pyramid is being replaced by a plate which health care professionals feel will be easier to follow and have a more positive impact on the nutritional status of the population.

My plates – eats a variety of foods and eat less of some foods and more of others. The main message is that fruits and vegetables take up half the plate, with the vegetable portion being a little bigger than the fruit section. The plate has been divided so that the grain section is bigger than the protein section. Because nutrition experts recommend you eat more vegetables than fruits and more grains than protein foods.

The plate is simple and useful and helps an individual to view his or her own plate a little differently.



UNIT – II:

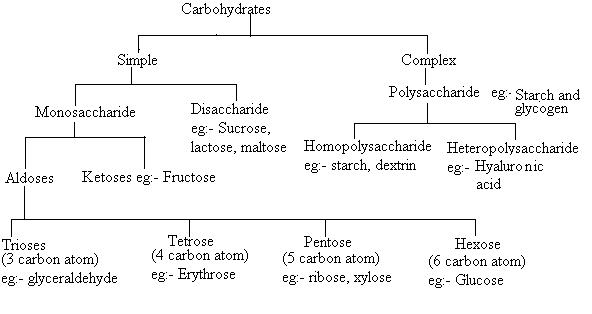
1. **Carbohydrates, Classification and Functions**

Energy that is needed to move, perform work and live is chiefly consumed in the form of carbohydrates. Carbohydrates, primarily starches, are least expensive, easily obtained and readily digested form of fuel.

**COMPOSITION**

Carbohydrates are organic compounds composed of carbon, hydrogen and oxygen, with the later elements in the ratio of 2:1. The general formula is CnH2nOn. They are viewed as hydrated carbon atoms.

C**lassification of Carbohydrates**



Carbohydrates are classified, depending on the number of sugar units they contain, as simple carbohydrate and complex carbohydrates.

Monosaccharide’s and disaccharides make up simple carbohydrates, called simple sugars containing one and two sugar units respectively. Polysaccharides called complex carbohydrates are structurally larger and more complex than simple sugars. They include starch, dietary fiber and glycogen.

There are two main classes of monosaccharide’s based on the carbonyl group present in them. They are aldoses and ketoses, aldoses (eg; glucose) containing the aldehyde group (CHO) and ketoses, (eg;- fructose) containing the ketone group (C=O).

Aldoses are further divided into trioses, tetroses, pentoses and hexoses based on the number of carbon atoms

The common disaccharides are Maltose, Lactose and Sucrose which on hydrolysis yield two monosaccharide units.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Maltose | |  | hydrolysis | |  | Glucose | + | Glucose |
| Lactose | |  | hydrolysis | |  | Glucose | + | Galactose |
| Sucrose |  |  | hydrolysis |  |  | Glucose | + | Fructose |
|  |  |  |  |  |  |  |  |  |

Polysaccharides have high molecular weight and are insoluble in water. They are in the form of long chains either branched or un-branched.

The polysaccharides are further classified into groups depending upon the products they yield on hydrolysis. Homopolysaccharides yield only one type of monosaccharide units on hydrolysis eg:- starch, dextrin, cellulose, glycogen

Heteropolysaccharides yield more than one type of monosaccharide units on hydrolysis eg:- Heparin, Hyaluronic acid. Heparin is an anticoagulant found in the liver, spleen, lungs and blood. Hyaluronic acid is found in the umbilical cord synovial fluid and vitreous humor. It has a lubricating action. In tissues it forms an important part of the cementing ground substance.

The sugars are also classified as reducing and non reducing sugar. The reducing property is attributed to the free aldehyde or keto group.

**FUNCTIONS**

Carbohydrates perform the following functions.

**1. Energy:** The principle function of carbohydrates is to serve as a major source of energy for the body. Each gram of carbohydrate yields 4Kcal of energy regardless of its source. In Indian diets 60 – 80 % of energy is derived from carbohydrate.

**2. Glucose:** Glucose is indispensable for the maintenance of the functional integrity of the nervous tissue and is the sole source of energy for the proper functioning of the brain.

Prolonged lack of glucose may cause irreversible damage to the brain.

**3. Protein Sparing Action:** Carbohydrates exert a protein sparing action. If sufficient amounts of carbohydrates are not available in the diet, the body will convert protein to glucose in order to supply energy. Hence to spare proteins for tissue building, carbohydrates must be supplied in optimum amounts in the diet. This is called the protein sparing action of carbohydrates.

**4. Fat Metabolism:** Carbohydrates are essential to maintain normal fat metabolism.

Insufficient carbohydrates in the diet results in larger amounts of fat being used for energy than the body are equipped to handle. This leads to accumulation of acidic intermediate products called ketone bodies.

**5. Synthesis of Body Substances: Carbohydrates** aid in the synthesis of nonessential amino acids, glycoprotein’s (which function as antibodies) and glycolipids (which form a part of cell membrane in body tissues especially brain and nervous system).

Lactose remains in the intestine longer than other disaccharides and thus encourages growth of beneficial bacteria.

**6. Precursors of Nucleic Acid:** Carbohydrates and products derived from them, serve as precursors of compounds like nucleic acids, connective tissue matrix and galactosides of nervous tissue.

**7. Detoxification Function:** Glucuronic acid, a metabolite of glucose serves as a detoxifying agent. It combines with harmful substances containing alcohol or phenolic group converting them to harmless compounds which are later excreted.

**8. Roughage of the Diet:** Insoluble fibers known as composite carbohydrates can absorb water and give bulk to the intestinal contents which aids in the elimination of waste products by stimulating peristaltic movements of the gastrointestinal tract.

**Food Sources**

  There are three main sources of carbohydrates (1) Starches (2) Sugars and (3) Cellulose.

(1)   Starches are present in cereals (eg. Rice, wheat, maize, sago, and all bakery products) pulses, potatoes, sweet potatoes, yam and dry fruits.

(2)   Sugars are present in cane sugar, jiggery, honey, jam, jellies, dry fruits, sweets and fresh fruits, eg. Banana, sapoto, grapes, mango.

(3)   Cellulose is the fibrous substance. eg. Whole grains, whole pulses

***Recommended Daily Dietary Intakes***

As carbohydrate is utilized as main source of energy, at least 40 percent of the total energy in the food should come from Carbohydrates.

In our country 60 – 80 percent of a day’s energy needs are met from carbohydrates in the form of starch furnished by cereals and pulses. In developed countries only 30 – 40 percent of days energy needs are met from carbohydrates

      There is no fixed amount recommended for carbohydrates, but even then it should provide about 60-70% of the total energy. The daily diet of an adult should contain at least 40 gms of dietary fiber.

***Deficiency:*** The energy needs are not met if the diets are deficient in carbohydrates. The work efficiency is lowered. Also person becomes underweight. Growth will be slow in the case of children. Symptoms of ketosis may also develop. If carbohydrates are consumed in excess they get accumulated as fat in the body leading to obesity and predisposes to diabetes and heart ailments. The energy needs are not met if the diets are deficient in carbohydrates. The work efficiency is lowered. Also person becomes underweight. Growth will be slow in the case of children. Symptoms of ketosis may also develop. Lack of dietary fiber in the diet leads to constipation and colon cancer.   If carbohydrates are consumed in excess they get accumulated as fat in the body leading to obesity and predisposes to diabetes and heart ailments.

**Hypoglycemia** : It is very important to have normal blood glucose level, when the glucose level in blood drops below normal value it is called low blood glucose or hypoglycaemia. Hypoglycaemia is generally seen in diabetics but it can happen if adequate amounts of carbohydrates are not consumed because all carbohydrates are converted into glucose. Hypoglycaemia can cause a feeling of dizziness, lethargy, confusion and triggers hunger.

**Ketosis** : When the body does not have adequate supply of carbohydrates to produce energy, it starts breaking down the fats to meet the metabolic demands. Ketones are produced in the process of fat breakdown and an excessive amount of ketones in blood is termed as ketosis, mild ketosis can cause nausea, headache, smelly breath and metal fatigue whereas severe ketosis can seriously damage the vital organs.

**Weight Gain**: Carbohydrate deficiency triggers hunger and leads to extra calorie consumption. Taking adequate amounts of low calorie, healthy carbohydrates keeps you full for longer and produces early satiety with the high fiber content.

**5. Classification, Functions** **and food sources of Proteins**:

 The word protein means to “take the first place”. In 1938 a Dutch Chemist Mulder, described that all living plants and animal contain certain substance without which life was not possible and this was identified as proteins. In constitution of body they stand next to the water. Indeed proteins are of the greatest importance in human nutrition.

They are complex organic compounds containing the carbon, hydrogen, oxygen, nitrogen, and usually sulphur. Some proteins also contain phosphorus, iron, iodine, copper and other inorganic elements. The proteins differ from carbohydrates and fat as they contain nitrogen, Proteins are made up of much smaller units known as amino acids.

Proteins may be classified on the Basis of structure

1. Simple proteins – These proteins are made up of amino acids only. Eg. Zein in corn, Albumin in egg white and gliadin in wheat.
2. Conjugated proteins – These proteins have a non-protein molecule attached to the protein Eg. Blood protein haemoglobin, which contains a heme(Iron) attached to protein and Milk protein casein which has a phosphate group attached.
3. Derived proteins – These results from a partial breakdown of a native protein. Proteoses, peptones and polypeptides are formed when digestive enzymes begin their action on proteins

**Function:** Proteins are very essential for life processes, as there is hardly any important physiological function in which proteins do not participate. The important functions of proteins are:

(1)  **Body building:** It is the most important function of protein. These are the major structural components of body tissues. Infact every living cell contains protein. The first need for proteins therefore is to supply the materials for the growth and development and the continuous replacement of the cell protein.

(2)  **Body Regulatory:** Many proteins have highly specialized functions in the regulation of body processes. All chemical reaction in the body are carried out by enzymes, which are protein in nature. Proteins are also a constituent of hemoglobin, which is necessary to carry oxygen from lungs to tissues and bring back CO2.Governing the body reaction are hormones, which are also proteins. Plasma protein has a fundamental role in the maintenance of water balance. Blood proteins also help in maintaining acid base balance of the body.

(3)  **Body protection:** There is a protein called gamma globulin, which has a capacity to fight against invading organism. The body’s resistance to disease is maintained in part by antibodies, which are protein in nature.

(4)  **Energy Yielding:** The energy needs of the body take priority over other needs, and if the diet does not furnish sufficient energy from carbohydrates and fats. The proteins of the diet as well as tissue protein will be used up for giving energy. One gram of protein gives 4 calories.

(5)  **Maintenance of body temperature:** During the metabolism of proteins extra heat is liberated, which is used for maintaining the body temperature.

**Food Sources:**  There are two main dietary sources of proteins

(1) **Animal source**: Milk and milk products excluding butter and ghee, eggs, meat, fish and poultry.

(2**) Plant sources**: Pulses e.g. Soybean, Bengal gram, red gram dal, green gram, black gram dal; Cereals e.g. wheat maize, rice, barley, jowar, bajra; and nuts e.g. peanuts, almond, cashew nuts. Fruits and vegetables are poor sources.

1. **FATS CLASSIFICATION AND FUNCTIONS**

Lipids more commonly known as fats and oil, are integral part of our food. They are insoluble in water but soluble in organic solvents. They occur in both plants and animals. Lipids are concentrated source of energy

Fat is an important component of our diets and serve a number of functions. These are also organic compound of carbon, hydrogen and oxygen. These differ from carbohydrates is that they have much smaller proportion of oxygen and much greater proportions of carbon and hydrogen.

**CLASSIFICATION**

Lipids are classified into simple, compound and derived lipids which are further subdivided as follows.

Lipids

|  |  |  |
| --- | --- | --- |
| Simple | Compound | Derived |
| a) Fats and oils | (a) Phospho lipids | (a)Sterols |
| b) Waxes | (b) Glyco lipids | (b)Fatty acids |
|  | (c) Lipo proteins |  |

**Simple lipids**

Fats and Oils are included in this type. At room temperature, oils are liquids and fats are solids. Fats and oils contain esters of fatty acid and glycerol, a form in which lipids are present in food.

**Compound lipids**

They are esters of fatty acids containing phosphorous carbohydrate or protein. Phospholipids contain a phosphoric acid in addition to the alcohol and fatty acids.

Glycolipids contain a fatty acid, carbohydrate and a nitrogenous base. Phospholipids and glycolipids form part of the cell membrane and the nervous system.

Lipoproteins are macromolecular complex of lipids with proteins.

**Derived lipids**

These are substances liberated during hydrolysis of simple and compound lipids which still retain the properties of lipids. The important members of this group are sterols, fatty acids and alcohol.

**Sterols**

Sterols are solid alcohols and form esters with fatty acids. In nature they occur in the Free State in the form of esters. Based on their origin sterols are classified as cholesterol (animal origin) and phytosterol (in plants).

Cholesterol is a complex type of lipid that is regularly synthesized by and stored in the liver. It is present in all animal products.

**Fatty acids**

Fatty acids are the main building blocks of fat. They have a methyl group (CH3) at one end and a carboxyl group (COOH) at the other end with a chain of carbon and hydrogen atom in the middle. They have a basic formula CH3(CH2)n COOH. Where ‘ n’ denotes the number of carbon atoms which may vary from 2 to 2l.

Fatty acids can be classified into Saturated Fatty Acids(SFA) and Unsaturated Fatty Acids (UFA)

**Saturated Fatty Acids**

Saturated fatty acids are those that are unable to absorb more hydrogen. They are usually stiff and hard fats. Eg. Ghee, and Butter.

**Unsaturated fatty acids**

Unsaturated fatty acids have one or more double bond in their molecule and are thus not saturated with hydrogen. They are liquid at room temperature. Eg. Sunflower oil.

Unsaturated fatty acids may be monounsaturated or polyunsaturated depending on the number of double bonds.

**Monounsaturated fatty acids (MUFA)**

MUFA have only one double bond in their molecule. Eg. oleic acid found in olive oil, peanut oil

**Polyunsaturated fatty acids (PUFA)**

PUFA have 2 or more double bonds in their molecule. Eg. linoleic acid, linolenic acid, and Arachidonic acid. They are present in corn, safflower, soyabean, sunflower oils and fish oils.

Monounsaturated and polyunsaturated fats are usually soft or liquid at room temperature.

The term fat is generally applied to all triglycerides regardless of whether they are solid or liquid at room temperature. Triglycerides from animal sources contain a higher percentage of saturated fatty acids and are normally solids at room temperature and known as fats.

The plant triglycerides are rich in unsaturated fatty acids and are generally liquids at room temperature and called oils.

*Essential Fatty Acids*

            Certain fatty acids should be provided essentially in the diets, as they are not synthesized in the body. These are polyunsaturated fatty acids, namely linoleic, linolenic and archidonic acids and are grouped as “essential” fatty acids. They are required for metabolism and for maintenance of normal health of the skin. .

**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.

**The functions of fats are:**

(1)  ***Energy fielding*:** Fats are concentrated source of energy. One gram of fat gives 9 calories. Compared to carbohydrate it not only gives more amounts of energy but at a faster rate too.

(2) ***Fats also perform the protein sparing action*** in the same way as carbohydrate does.

(3)  ***Storehouse of energy for the body’s needs:*** In fact not only amount of fats as such are stored in adipose tissue, but any amount of glucose, amino acids, not promptly utilized are also synthesized and stored in the body, thereby energy is continuously available from the stores in adipose tissues.

(4) ***Insulation and padding:*** The subcutaneous layer of fat is an effective insulator and reduces losses of body heat in cold weather, thus regulating the body temperature. The vital organs such as the kidneys are protected against physical injury by a padding of fat around the organs.

(5)  ***Fats help in absorption and transportation*** of fat-soluble vitamins in the body.

(6) ***Provides essential fatty acids:*** Fat is also the source of certain fatty acids which are essential for metabolism and for maintaining a normal skin.

(7) ***Fats acts as a lubricant***for various body organs especially the organs of the gastrointestinal tract.

(8) ***Gives satiety value:*** Fat depresses the secretion of hydrochloric acid in the stomach, thus the food stays in the gastrointestinal tract for a longer time and feeling of hunger is delayed.

(9)  ***Fat also increases the palatability*** of the diet by adding flavor to many cooked preparations.

*Food Sources*

Dietary fats are derived from two main sources

(1) *Animal sources*: It includes butter, ghee, curd, whole milk, and its products meat, fish, poultry, and eggs.

(2) *Plant sources*: They include all vegetables oils e.g. groundnut, *gingili*, mustard, cottonseed, sunflower, and coconut oil. Also it will include hydrogenated fats, margarine, nuts and oil seeds like cashew nut, peanuts, almonds, and mustard seeds.

***Recommended Daily Dietary Intakes***

The fat requirement mainly depends upon the energy needs of the individual. From physiological point of view there can be wide variation in fat intake and still good health can be maintained. On an average about 15-20% of the total energy should be supplied from fats. The dietary fats should be a good source of essential fatty acids and hence at least 50% of  the dietary fat should be from vegetables oils rich in essential fatty acids.

**VITAMIN A- FUNCTIONS AND DEFICIENCY SYMPTOMS**

         Vitamin A was discovered in the early nineteenth century by Dr. McCollum and Davis. Dr. McCollum carried out experiments on rats and found that when butter and egg yolk were added to the diet of group of rats, they were healthier, stronger as compared to the other group which was fed on lard and vegetables only. He came to the conclusion that butter and egg yolk contain some vital elements that were absent in lard and vegetables. In 1913, he isolated vitamin A from butter and egg yolk.

***Chemistry***

Vitamin A occurs in several forms: as retinal, as retinal, as an aldehyde and as retinoic acid. These several forms may be referred to as vitamin A. In its pure form, vitamin A is a pale yellow crystalline compound and occurs naturally in animals. It is soluble in fat solvents but insoluble in water, and is relatively stable to heat, acids and alkalis. It is easily oxidized and rapidly destroyed by ultra-violet radiation.

            The ultimate source of all vitamin A is in the carotenes which are synthesized by plants. Animals, as well as man in turn convert a considerable portion of carotene of the foods they eat into vitamin A. Carotenes are dark-red crystalline compounds also known as “Pro-vitamin A” or “precursors of vitamin A”. Alfa, Bita, Gama, molecules of carotene are of significance in nutrition. Each molecule of beta-carotene yields two molecules of vitamin A.

***Functions***

1. Vitamin A is required for normal vision in dim light. The retina has two kinds of cells-rods and cones. Rods are sensitive to dim light; the cones respond to bright light.

2. The rods contain a pigment called rhodopsin. Rhodopsin is formed by the combination of a specific form of vitamin A with a protein.

3. Rhodopsin in the presence of bright light, breaks down into it components. In the dark these components, Vitamin A and protein again combine to regenerate rhodopsin. This rhodopsin helps us to see in dim light. This is called a visual cycle.

4. Vitamin A is required to maintain the integrity of epithelium, especially the

Membranes that line eyes, the mouth, and the gastrointestinal, respiratory, and genitourinary tracts. These membranes resist bacterial invasion.

5. Vitamin A is essential for normal skeletal and tooth development.

6. It has a probable role in the immunological defense mechanism of the body.

**Sources:** Vitamin A in the human diet exists as retinol or as retinal or beta carotene which has to be converted to Vitamin A. Foods of animal origin contains retinol. Plant sources are rich in Beta carotene. Only one third of the dietary beta Carotene is absorbed. Beta Carotene from green leafy vegetables is well utilized than from carrots and papayas. Good sources of Vitamin A are sheep liver, butter, ghee, egg, milk, curds, liver oils of shark and halibut. Good sources of beta carotene are Agatha, amaranth, drumstick leaves, green leafy vegetables, mango, papaya, and carrot and jack fruit.

***Deficiency symptoms:***

1. *Xerophthalmia* is an eye manifestation arising due to vitamin A deficiency. Blindness, as a result of xerophthalmia, is an important public health problem in India. One of the earliest manifestations of xerophthalmia is *night blindness.*
2. This is followed by *conjunctiva xerosis* which means, dryness of the conjunctiva. In addition, to *xerosis*, dry foamy, triangular spots may appear on the conjunctiva. These are called *Bitot’s* spot.
3. As in the case of conjunctiva, the normal cornea of the eye is moist and  shining, when vitamin A deficiency become severe, the cornea becomes dry and dull and appear like ground glass. This condition is called corneal *xerosis* which means dryness of the cornea the most dangerous form of *xerophthalmia* is known as *keratomalacia*.
4. In this condition, the cornea become very soft and raw and easily infected. It leads to destruction of the eye. The eyes get completely melted and destroyed . This condition leads to *irreversible blindness*.
5. The deficiency of vitamin A leads to the *degeneration and keratinization of the epithelium.*This increase the susceptibility to infection of the eye, nasal passages, middle ear, pharynx, mouth, respiratory tract, lungs, and genitourinary tract.
6. Dry and scaly skin is an important symptom of a deficiency of this vitamin. This patched skin is an important symptom of a deficiency of this vitamin. This patched skin is termed as *toad’s skin.*

**VITAMIN D**

Pure Vitamin D was isolated in crystalline form in 1930 and was called *calcifierol*. It was also known as antiranchitic vitamin.

***Chemistry and Characteristic***

Vitamin D is a group of sterol compounds possessing anti-rachitic properties, but only two are of nutritional interest. (i)*Vitamin D2* or Ergocaliciferol found in a plants and (ii) *Vitamin D3* or cholecalciferol which occurs in animal cells and activates in the skin on exposure to ultra-violet light. Pure Vitamin D is white, crystalline compounds which are soluble in fats and fat solvents, but insoluble in water. They are stable to heat, alkalis and oxidation.

***Functions***

1. Vitamin D regulates the absorption of calcium and phosphorus from the intestinal tract and also calcification of bones and teeth. It is believed that vitamin D renders the intestinal mucosa more permeable to calcium and phosphorus. Thus vitamin D is required for normal bone and teeth development.
2. Vitamin D regulates the enzyme ‘alkaline phosphates’ which regulates the release of phosphate organic compounds.

3. Absorption in the gastro intestinal tract.

4. Retention by the kidney

5. Vitamin D helps in deposition of calcium in the bones.

6. The bones grow denser and stronger.

***Food Sources:***Vitamin D occurs only in foods of animal origin. Fish liver oils are the richest natural source. Liver, eggs and butter contain useful amount**.** Small amounts are present in fresh milk and milk products.

            Another cheap source of vitamin D is sunlight. Exposure to ultraviolet rays of the sunlight converts the precursor of vitamin D (7-dehydrocholestrol) present in the skin, to its active form.

***Recommended Daily Allowances***

The recommended daily allowances of Vitamin D are not fully known for the present. 200 IU of Vitamin D can be taken as tentative value. If exposure to sunlight is sufficient, deficiency symptom are not seen.

***Deficiency:*** Deficiency of vitamin D leads to *Rickets*in Children, a condition in which the level of calcium and phosphorus is always low.

Bone growth cease and in more severe cases the bone which has already formed may be demineralised. This results in clinical changes which are observed by the swelling or bending of ribs. This condition is known as ‘*rachiticrosary***.**

The long bones increase in at the ends and they may become curved instead of remaining straight. This leads to *‘knock-kees’*, bowed legs, curvature of vertebral column and deformities of the pelvic bones. Softening of the skull, particularly in infants and the delayed closing of fontanels is another feature of the deficiency of this vitamin.

Deficiency in adults leads to *Obsteomalacia*, a condition in which bones become fragile so that they are susceptible to fracture. 

            In old age a deficiency of both vitamin D and calcium leads to *Osteoporosis*, a condition in which bones become porous and break easily.

**VITAMIN E**

            Evans and Bishop established the fact that a fat soluble factor was necessary for reproduction in rats. They showed that the absence of this factor, or vitamin E, as it was designated, leads to infertility in rats.

***Chemistry and characteristic***

            Vitamin E consists of a group of chemical substances called ‘tocopherols’. Alphatocopherol is the compound possessing the greatest vitamin E activity. High temperature and acids do not affect the stability of this vitamin, but oxidation takes places in the presence of rancid fats or lead and iron salts. Decomposition occurs in ultraviolet light, alkalis and oxygen.

***Functions***

1. The primary role of vitamin E is to act as an anti-oxidant. By accepting the oxygen, it helps to prevent the oxidation of vitamin A in the intestine, thereby sparing vitamin A.
2. Vitamin E reduces the oxidation of the polyunsaturated fatty acids, thereby helping to maintain the integrity of the cell membranes.
3. Vitamin E plays a part in the formation of RBC’s in the bone marrow.
4. It helps in releasing the energy from carbohydrates and fats, through the synthesis of a coenzyme Q.

5. In some animals vitamin E is required to prevent the sterility.

6. Vitamin E reduces platelet aggregation

7. Vitamin E is essential for the iron metabolism and the maintenance of

Nervous tissues and immune function.

8. Vitamin E is been promoted as an anti-aging vitamin, because as cells age

They accumulate lipid breakdown products.

9. Vitamin E prevents this accumulation in maintaining cell health.

***Food Sources***

Many vegetables oils such as wheat germ oil and cotton seed oil are good sources of   vitamin E. Good concentration of vitamin E is present in dark-green leafy vegetables, nuts, legumes, as well as whole-grain cereals. Although foods of animal origin are low in vitamin E, **liver**, heart, kidney milk and eggs are the animal sources of this vitamin. Human milk provides an adequate amount of vitamin E to infants; cow’s milk is low in this vitamin.

***Recommended Daily allowances***

            The vitamin E requirement is linked to that of essential fatty acids. The requirement of vitamin E suggested is 0.8 mg/g of essential fatty acids.

***Deficiency***

            Vitamin E deficiency results in increased haemolysis (break down) of the red blood cells leading to anemia. Premature infants also show a low level to tocopherol. In some species of animals, vitamin E deficiency is known to cause reproductive failure. In human beings vitamin E deficiency is not frequently reported.

1. Defective functioning of the retina leading to permanent blindness in premature infants occurs.
2. It leads to reproductive failure in humans
3. Vitamin E deficiency is associated with decreased ability

of the lymphocytes.

**UNIT – III:**

**VITAMIN C** – **FUNCTIONS AND DEFICIENCY SYMPTOMS**:

***Chemistry and Characteristics***

            Vitamin C is a white crystalline compound of relatively simple structure and closely related to monosaccharide sugars. It can be prepared synthetically at low cost from glucose. Of all the vitamins, Vitamin C is the most easily destroyed. It highly soluble in water heat, light, alkalis, oxidative, enzymes and trace.

The chemical name for Vitamin C is ascorbic acid. It was discovered in 1747 by the British physician Lind and demonstrated that citrus fruit juices prevented and cured scurvy.

**Functions:**

1. Ascorbic Acid is essential for formation of cement substances and collagen which is found in blood vessels teeth and bones.
2. It helps in the biosynthesis of non-essential amino acids (eg) hydroxy proline, tyrosin.
3. It is required for absorption of iron as it reduces ferric to ferrous form which is easily absorbed.
4. Vitamin C is essential for the formation of collagen a major structural protein of connective tissues.
5. It is required for normal wound healing because it helps in the formation of connective tissue.
6. Vitamin C is required for carnitine synthesis which aids in the transport of fatty acids in the cell.
7. Vitamin C is essential for the neither synthesis of nor epinephrine a neurotransmitter.
8. It activates hormones (eg) growth hormone, gastrin releasing peptide, calcitonin, gastrin oxytocin.
9. Drug detoxifying metabolic systems in the body require Vitamin C for its optimal activity.
10. Vitamin C is an excellent anti-oxidant. It combines with free radicals oxidizing them to harmless substances that can be excreted.

***Food Sources***: Fruits and vegetables are the main sources of this vitamin. Citrus fruits (oranges, grapes, fruits, lemons and limes) berries, melons, pine-apples, guavas, pears, banana, apple, leafy vegetables, green pepper, amla, tomatoes are good source of ascorbic acid. Dry legumes contain negligible amount which increase approximately seven times, during germination. Milk, eggs, meat and poultry do not have any Vitamin C. Human milk contains four to six times as much ascorbic acid as cow’s milk to protect the infant from scurry.

**Effects of Deficiency:** Prolonged deficiency of ascorbic acid produces a disease condition called as ‘ scurvy’ in both infants and adults.

**Infantile scurvy:**

There is loss of appetite, failure to gain weight, irritability, palor, defective growth of bones. Haemorrhage occurs under the skin. There is defective formation of teeth and gums are swollen. The ends of the ribs become prominent resulting in beaded appearance called scorbutic rosary.

**Adult Scurvy:**

1. General manifestation is fever, susceptibility to infection, and delayed wound healing.
2. Anemia: Microcytic hypo chromic anemia develops due to failure of absorption of iron.
3. Gums become spongy and bleed easily. Gums become swollen and ulcerated.
4. The blood vessels become fragile and porous due to defective formation of collagen. Joints become swollen and tender.

Clinical symptoms appear when total body pool of ascorbic acid decreases. Skin becomes rough and dry. There are small petechial hemorrhages around hair Follicles.

**Thiamine: Vitamin B1**

Thiamine is known as Vitamin B1. Deficiency of thiamine leads to beri – beri. This condition is widely prevalent among population whose diet contains more of polished cereals.

**Functions**

1. Thiamine is converted to thiamine pyrophosphate (TPP), which is an important co enzyme in the carbohydrate metabolism.
2. It is involved in transmission of nerve impulses across the cells
3. Thiamine as TPP is an essential cofactor for the conversion of amino acid tryptophan to niacin.
4. Yeast, whole wheat, millets, hand pounded rice, parboiled rice are good sources of thiamine. The bran contains most of the thiamine in the cereals. Gingelly seeds, groundnut, soya bean, cashew nuts, organ meats, pork, liver and eggs supply thiamine.
5. Thiamine is involved in the carbohydrate metabolism. Its requirement is related to energy derived from carbohydrate. The ICMR expert group recommends an allowance of 0.5 mg per 1000 Kcal for adults and for infants 0.3 mg/1000 Kcal is suggested.

**Effects of Deficiency**

Deficiency of thiamine is associated with low calorie intake. Severe deficiency of thiamine produces a disease known as beri – beri.

It is manifested as

* 1. Dry beri – beri
  2. Wet beri – beri
  3. Infantile beri – beri

In later stages complete loss of sensation in hands and legs occur. It is characterized by foot and waist drop. Mental depression and confusion occurs.

**a. Dry beri – beri**

There is loss of appetite, tingling numbness and burning sensation in hands and feet. Calf muscles are tender. Knee and ankle jerks are sluggish. In later stages complete loss of sensation in hands and legs occur. It is characterized by foot and waist drop. Mental depression and confusion occurs

**b. Wet beri – beri**

In this case there is enlargement of heart and the cardiac output is high. Oedema or accumulation of fluid in legs, face and trunk is observed. palpitations are marked.

**c. Infantile beri – beri**

It occurs in first few months of life if the diet of the mother is deficient in thiamine. Symptoms are restlessness, sleeplessness, constipation, enlargement of the heart and breathlessness.

**Riboflavin: Vitamin B2.**

Riboflavin or Vitamin B2 is the yellow enzyme which is heat stable unlike other B Vitamins. Riboflavin in the combined form with proteins forms flavo proteins or yellow enzymes.

This enzyme is of two types FAD – Flavin-di-nucleotide and FMN- Flavin mono-nucleotide.

a. These substances act as coenzymes in many biological reactions primarily in oxidation – reduction, and dehydrogenation reactions.

b. Release of energy from glucose, fatty acids and amino acids.

c. Conversion of vitamin B6 and folate to active coenzymes.

d. It is essential for the formation of red blood cells

e.It is required for the synthesis of glycogen

**Food Sources:** Rich sources are liver, dried yeast, egg, milk , meat, fish, whole cereals, legumes, and green leafy vegetables.

**Requirements**: Riboflavin requirement is related to energy intake – 0.6 mg/1000Kcal.

**Effects of Deficiency**

Riboflavin deficiency is prevalent mainly among the low income groups particularly the vulnerable group and the elderly adults. Riboflavin deficiency is characterized by

1. Soreness and burning of the mouth and tongue.
2. Lesions at the angles of the mouth called Angular Stomatitis.
3. The inflammation of the tongue called glossitis
4. Dry chapped appearance of the lip with ulcers termed cheilosis.
5. The skin becomes dry and results in seborehoeic dermatitis.
6. Photophobia, lacrimation, burning sensation of the eyes and visual fatigue.
7. Decreased motor co-ordination
8. Normocytic anaemia

**Folic Acid**

Folic acid was first extracted from dark green leafy vegetables. It forms yellow crystals and is a conjugated substance

***Characteristics*** :   Folain is a generic term for folic acid, pteroyglutamic acid and other compounds having the activity of folic acid. It consists of three linked componets: a *pteridine grouping*, *para-amino*-*benzoic* acid, and *glutamic acid*, an *amino acid*. Pure folic acid occurs as a bright yellow crystalline compound, only slightly soluble in water. It is easily oxidized in an acid medium and is sensitive to light. Made up of three acids namely pteroic, para amino benzoic acid and glutamic acid.

**Functions**

1. Folic acid coenzyme is essential in bringing about transferring single carbon units for many interconversions. A number of key compounds are formed by these reactions like

(i) Purines which are essential constituents of living cells.

* 1. Thymine – this essential compound forms a key part of DNA.
  2. The formation of haem group of haemoglobin.

(vi) The conversion of phenylalanine into tyrosin.

**Food Sources:** Green leafy vegetables, liver, kidney, gingelly seeds, cluster beans, are rich sources of folic acid.

**Requirements:** The recommended dietary allowances of Folic acid by ICMR are given in table

**ICMR Recommended Dietary Allowance for Folic acid**

|  |  |
| --- | --- |
| **Group** | **Folic acid mg/day** |
| Man | 100 |
| Woman | 100 |
| Pregnant woman | 400 |

**Deficiency**

1. Simple folate deficiency results in the bone marrow producing immature cells (megaloblasts cells) and few matured red blood cells. These results in reduced oxygen – carrying capacity causing anemia termed - Megaloblastic anemia.
2. Folate deficiency during pregnancy causes neural tube disorders of the fetus.
3. Folate deficiency impairs the ability of the immune system to fight infection.

**Importance of folic acid in women’s health.**

Folate is important for a range of functions in the body. It helps the body make healthy new red blood cells, for example. Red blood cells carry oxygen throughout the body. If the body does not make enough of these, a person can develop [anemia](https://www.medicalnewstoday.com/articles/158800), leading to fatigue, weakness, and a pale complexion. Without enough folate, a person can also develop a type of anemia called [folate deficiency anemia](https://www.medicalnewstoday.com/articles/325310). Folate is also important for the synthesis and repair of DNA and other genetic material, and it is necessary for cells to divide. Getting enough folate during pregnancy is particularly important. This is because folic acid is crucial for early fetal development, particularly with regard to the spinal cord. During pregnancy, folate deficiency increases the risk of congenital irregularities.

Before**and**during**pregnancy.** Folic acid protects unborn children against serious birth defects called neural tube defects. These birth defects happen in the first few weeks of pregnancy, often before a woman knows she is pregnant. Folic acid might also help prevent other types of birth defects and early pregnancy loss (miscarriage). Since about half of all pregnancies in the United States are unplanned, experts recommend all women get enough folic acid even if you are not trying to get pregnant her a vitamin nor a mineral.