FHFN PART UNIT 3, 4 AND 5; FOR MID – 2.

1. **Deficiency of Iodine**: Iodine deficiency in the diet causes enlargement of the thyroid gland called as "goiter". Goiter occurs in people staying in hilly regions where the iodine content of water and soil is comparatively less. Severe iodine deficiency in children leads to hypothyroidism resulting in retarded physical and mental growth. This condition is known as cretinism.

2. **Deficiency of Fluorine**: On one hand fluorine is required for deposition of fluorides on teeth and discourages the solubility of minerals and growth of acid forming bacteria. If there is a deficiency of fluorine during the growing period, it will result in dental caries and tooth decay. On the other hand, when taken in excess it could damage teeth and bones. This condition is known as dental fluorosis.

3. **Boiling:** In this method the foodstuffs are cooked in boiling water. Thus, the food comes in direct contact with water. In this the foodstuffs are immersed in water in a suitable container, covered with a lid and the heat is applied.

4. **Steaming**: Steaming is also a method of cooking food with water, but in this case, the food does not come in direct contact with water. In this method the food is cooked by the heat generated by steam and hence takes a slightly longer time, as compared to boiling.

5. **Baking:** It is cooking of food in hot air in a closed oven. The food to be cooked is kept in a preheated oven, where it is surrounded by hot air in the closed oven, thus getting cook by the dry heat. Usually, the oven is heated to a particularly temperature according to the food which is to be baked and this temperature is maintained throughout the cooking period.

6. **Grilling**: it is cooking of food by direct heat over a hot fire or under a grill; this is also method of cooking of direct heat. Usually, the food is put on grill bars and is cooked over direct heat with the help of little fat.

7. **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.

8. **Dietetics**: It is the science and art of feeding individuals or groups under different health and economic conditions according to the principles of nutrition and management.

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9. **List of B Group Vitamins:** thiamin (B1), riboflavin (B2), niacin (B3), Pantothenic acid (B5), Pyridoxine (B6), Biotin (B7), folate or folic acid (B9) and Cyanocobalamin (B12).

10. **Methods of moist heat**: Boiling, stewing, steaming, pressure cooking, poaching and blanching.

11. **Methods of dry heat**: Roasting, grilling, toasting, baking, sautéing and frying.

12. **Advantages of boiling**: It is the simplest method of cooking. It does not require special skill and equipment. Uniform cooking can be done. The food cooked is light and easily digestible. If the amount of water is proportionate to the quantity of food to be cooked and the food is cooked covered, the nutrients are retained in the food to a large extent.

13. ***Advantages of roasting****:* Compared to baking, it is quicker method of cooking. A variety of foodstuffs can be prepared by roasting. It requires less or no fat. Flavor is improved. It reduces the moisture content of food and improves keeping quality. It is easy to powder e.g. cumin seeds after roasting

14. **Antioxidants** are man-made or natural substances that may prevent or delay some types of cell damage. Antioxidants are found in many foods, including fruits and vegetables. They are also available as dietary supplements. Examples of antioxidants include **vitamins C and E, selenium, and carotenoids**, such as beta-carotene, lycopene, lutein, and zeaxanthin. These vitamins act both singly as well as synergistically for the prevention of oxidative reactions leading to several degenerative diseases including cancer, cardiovascular diseases, cataracts etc.

15.GM foods: Genetically modified (GM) foods are foods derived from organisms whose genetic material (DNA) has been modified in a way that does not occur naturally, e.g. through the introduction of a gene from a different organism**.** Some benefits of genetic engineering in agriculture are increased crop yields, reduced costs for food or drug production, reduced need for pesticides, enhanced nutrient composition and food quality, resistance to pests and disease, greater food security, and medical benefits to the world's growing population.

16.Nutraceuticals: The food source used as nutraceuticals are all natural and can be categorized as – dietary fiber, probiotics, prebiotics, polyunsaturated fatty acids, antioxidant vitamins, polyphenols and spices.

17.Minerals: the human body contains more than 19 minerals, all of which must be derived from foods. A total of 4% of the body weight is made up of minerals. Some of

the important minerals found in our body include calcium, phosphorus, iron, iodine, sodium, potassium, zinc and chloride. All these minerals are derived from the food we eat. Of these, calcium, phosphorus, sodium, potassium, chloride and magnesium are the minerals required in larger amounts by the body.

18.Probiotics: A probiotic can be defined as live microbial feed supplement, which when administered in adequate amounts beneficially affects the host animal by improving its intestinal microbial balance.

19.. **Prebiotics:** Prebiotics are dietary ingredients that beneficially affect the host by selectively altering the composition or metabolism of the gut micro biota.

21.**Dietary fiber**: Dietary fiber is the food material, more precisely the plant material that is not hydrolyzed by enzymes secreted by the digestive tract but digested by micro flora in the gut.

20**.Phytochemicals**: Phytochemicals are a large group of non-nutrient secondary metabolites present in vegetables and fruits. A few of the well-known phytochemicals are generally grouped into the alkaloids, terpenoids, and phenolic compounds. Among all phenolic compounds, the most common phytochemical includes flavonoids, phenolic acids, and polyphenols.

ESSAY QUESTIONS

CALCIUM

On the approximately 1200g of calcium present in the adult body, 99 per cent is in the bones and teeth and remaining 1 per cent is widely distributed in body fluids where it fulfills many functions.

Functions

1) Calcium together with phosphorus and other elements gives rigidity to bones and teeth. This characteristic makes it possible for the bone to the support of the body. Bone forms protective cavities for vital organs – the heart and lungs in the chest cavity, the brain in cranial cavity.
2) Calcium acts as a catalyst for the conversion of prothrombin to Thrombin, this being one of the several steps in the clotting of blood.
3) It activates the permeability of the cell membrane (regulating the Passage of substances into and out of cells).
4) It activates number of enzymes including lipase, adenosine.

Triphosphatase and some proteolyses enzymes.

5) It has a role in the transmission of nerve impulses (conveying message from one nerve cell to another).
6) It is directly related to muscle contraction. In the absence of calcium, muscles lose their ability to contract.
7) It aids in the absorption of vitamin B12 from the ileum.

Food Sources: Milk and milk products are excellent sources of calcium. Certain green leafy vegetables such as mustard green, turnip greens, mint, spinach, and carrot leaves rank next to dairy products in their calcium content. Citrus fruits, legumes, meats grains and nuts provide the least calcium.

Deficiency: A deficiency of calcium in the diet results in retarded calcification of bones and teeth in the young. Due to the deficiency of calcium bones start bending and there is enlargement of ankle and wrists.

In children, the deficiency disease is known as *Rickets* and in adults, as *osteomalacia*. Repeated pregnancies coupled with inadequate dietary intake can also give rise to the deficiency of calcium.

IRON

Iron is chief among the trace elements required for the body. In an adult male it is approximately 3 to 5 g and in woman about 2 to 3 g. A major portion of the iron is in the red blood cells as hemoglobin. Muscle tissues contain about 3 per cent of iron as myoglobin and the rest is stored as ferreting, haemosiderin, and siderophillin in liver, spleen, kidney and bone marrow.

Functions

1.Iron is a major constituent of a red-colored compound called hemoglobin presents in the blood. Iron is present in the hemoglobin.

2. Hemoglobin (Hb) is necessary for transport of oxygen to various parts of the body. Hb carries oxygen from the lings to the tissues and in turn helps in carrying carbon dioxide from the tissue to the lungs. From the lungs carbon-dioxide is then exhaled out.

3. Iron is also present in the muscle in the form of myoglobin. Myoglobin has the capacity to store oxygen. This oxygen is used for muscle contraction and for other immediate needs of the muscle cells.

4. Iron facilitates the complete oxidation of carbohydrate fats and proteins within the cell.

5. Iron plays on important role in maintenance of specific brain. Iron forms a vital component of certain enzymes and substances that aid in metabolism.

6. Iron has protective function. It helps in preventing infections.

Food Sources: Lean meats, deep green leafy vegetables and whole-grain cereals are good sources. Egg, yolk and organ meats are also among good sources. Liver is an excellent source of iron. Other vegetable and fruits are fair source. Milk, cheese and ice-ream are poor sources. Jiggery contains a good amount of iron.

Recommended Daily Allowances: The requirement of iron for the body is small, but due to poor absorption, much more is needed. From a vegetarian diet only 10% of the dietary iron is absorbed. For a mixed diet 15-20% absorption takes place.

Deficiency: Dietary iron deficiency leads to nutritional anemia. Nutritional anemia is defined as the condition that results from the inability of the erythropoietin tissue to maintain a normal hemoglobin concentration.
Anemia occurs when the hemoglobin level falls below 12 gm /dl in adult man and woman. During pregnancy hemoglobin level below 11 gm /dl is termed anemia.
Nutritional anemia is the common form of anemia affecting women in reproductive years, infants and children which is mainly due to poor intake and absorption.
Iron deficiency anemia is widespread in our country. The prevalence varying from 45% in men and 70% in women and children. The major cause of anemia in India is because of Iron and folic acid deficiency.

Nutritional anemia is manifested as:

1. Reduced Hemoglobin level. (less than 12 g /dl)
2. Defects in the structure, function of the epithelial tissues
3. Paleness of skin and the inside of the lower eyelid is pale pink
4. Fingernails becoming thin and flat and eventually (spoon shaped nails)

koilonychias develops.

5. Progressive untreated anemia results in cardiovascular and respiratory changes leading to cardiac failure. The general symptoms include lassitude, fatigue, breathlessness on exertion, palpitations, dizziness, sleeplessness, dimness of vision, and increased susceptibility to infection.

UNIT - IV

COOKING METHODS:

1.MOIST HEAT METHOD

These are the methods in which we use the heat generated by water in some form or the other. The methods include boiling, steaming, pressure-cooking, and stewing.

Steaming

Steaming is also a method of cooking food with water, but in this case, the food does not come in direct contact with water. In this method the food is cooked by the heat generated by steam and hence takes a slightly longer time, as compared to boiling.

Steaming is done in two ways i.e. direct steaming and indirect steaming.

Direct Steaming – In this method, the food comes in direct contact with the steam, direct steaming can be done in an ordinary steamer or in an improvised steamer as described below. Take sufficient water in a suitable container and allow it to boil to generate steam. The food to be cooked is kept in a metal strainer over this utensil and it is covered tightly with a lid. This way the steam rising from the water below rises and comes in direct contact with the food kept in the strainer, thus cooking it. The water in the container is maintained at boiling temperature throughout the process of steaming. For example, steaming of cut vegetables, or sprouted pulses, fish, idly, Dhosha etc.

Indirect Steaming – In this method, the food does not come in direct contact with the steam but is cooked the heat of the steam surrounding the container containing the food material. The water is boiled in a utensil. The food to be steamed is kept in a smaller container, which can be closed from the top and then placed in this utensil containing water. The utensil containing water is also covered with a tight-fitting lid. As the boiling water forms the Steam, it surrounds the container contain food, which gets cooked by the heat of this surrounding steam. The process takes a slightly longer time than the direct method of steaming. The heat has to be maintained throughout the process so that the formation of steam continues. Examples of indirect steaming are steaming of puddings like custards etc.

Advantages

1. Whether cooked by direct or indirect method the food is soft, easy to digest and hence ideal for the elderly and sick people particularly those with a weak digestion.
2. The food is tasty and full of flavor.
3. The food retains maximum nutritive value particularly in the indirect method of steaming, there is practically no loss of nutrients, however some amounts of water soluble nutrients i.e. vitamins of B group and vitamin C are lost in direct method of steaming but the nutrients losses are much less as compared to boiling.
4. The food cannot be easily over-heated.
5. It does not require constant attention.
6. Texture of the food is better and becomes light and fluffy.
7. Steamed foods have good flavor.

Disadvantages

1. It is a slow process of cooking and only easy to cook foods can be prepared by this method.
2. If sufficient amount of water is not there in the lower container, it might evaporate completely and the container starts burning even before the food is cooked.

2. DRY HEAT METHOD

Frying

This is a method of cooking in which the food is cooked by the heat of hot fat. Fat or oil can be heated to a much higher temperature, as compared to water and thus, as the food meets this heated fat, it gets cooked quickly. Fried food is very tasty and hence popular in our meals.

There are three types of frying: (1) Sautéing (2) Shallow fat Frying (3) Deep fat frying.

a) Sauteing

This means to toss the foodstuff in a little amount of heated fat, till it is partially cooked and absorbs the fat. The food is tossed occasionally or turned over with a spatula to enable all the pieces to meet the oil and get cooked evenly. Sometimes the pan is covered till tender in its own steam. The product obtained in cooked by this method is slightly moist, tender but without any liquid or gravy. It is usually done as a pre-preparation step in many dishes e.g., Sautéing of vegetable in the preparation of vegetable pulao, or Sautéing of noodles, thin pieces of meat etc.

b) Shallow fat Frying

In this method a shallow pan like frying pan or an ordinary griddle is used in which the food is fried in little amount of fat. During frying it is turned over, so that it may be evenly browned on both the sides. In this case also, the fat used is usually absorbed by the foodstuff. The Preparation generally cooked by this method is Paratha, omelet, tikkas, pancakes etc.

Some food contains sufficient fat in them like bacon and sausages. Hence these can be fried with the addition of any fat.

c) Deep fat frying

The food is completely immersed in hot fat and therefore a deeper utensil like karahi and a large quantity of fat is required. The fat is heated in the karahi and as it becomes hot, the food to be fried is put in it which gets cooked quickly. Common preparations which are made by this method are poories, pakoras, cutlets, samosas etc. While deep frying care should be take to see that the fat does

not get overheated, as the fat decomposes at high temperature, which not only spoils the taste of the food, but is even harmful for our body. At the same time if the fat is not hot enough, the food can break up and absorbs extra fat, thus making it very greasy. Therefore, it is important to judge that the fat has been heated to the right temperature which can be done by the following ways:

(a) When the fat starts giving a light smoke and becomes still it indicates that it has been heated to the right temperature.

(b) If one-inch square piece of bread becomes golden brown and crisp in 1minute, then the temperature of such fat is right for frying.

(c) Similarly, an easy way is to just try a little piece of the food first and if fries all right, then proceed with the rest.

Both sweets and savories can be cooked by this method. Food cooked by deep fat frying has a much better appearance as compared to shallow fat frying as the food is evenly browned and is crisp. Though, initially large quantity of fat is required in deep fat frying but the net absorption of fat by the food is less in deep fried foods, as compared to shallow fried foods.

Advantages of frying

(1) It is quick method of cooking.

(2) Fried food is very appetizing and tasty.

(3) Fried foods have better keeping quality e.g.poories can be kept for a longer time as compared to chapattis, without spoiling their taste and flavor.

(4) Frying introduces variety in the meals, as fried foods are crisp in texture.

(5) Fried foods have a higher satiety value.

(6) It increases the calorific value of food.

(7) In shallow fat frying, the amount of oil consumption can be controlled.

Disadvantages of frying

1. Fried foods are difficult to digest as the food gets covered with a layer of fat first.
2. Due to high temperature the nutrient losses are higher particularly of fat-soluble nutrients.
3. As fats and oils are expensive, it is not an economical method of cooking.
4. Sometimes the food may become oily or soggy with too much absorption of oil.

5. More attention is required while cooking and care should be taken to avoid accidents.
6. Repeated use of heated oils may produce harmful substances and reduce the smoking points.

3.EFFECTS OF COOKING ON NUTRITIVE VALUE OF FOODS:

Several changes occur in food during its preparation. To obtain acceptable food products, it is necessary to understand and manipulate these changes. Basically, the change is the net result of the changes of various components of food viz. its nutrients like carbohydrates, fats, proteins, their derivatives, and water. In addition, changes occur due to various inorganic, mineral components and several pigments, flavor components, vitamins, acids, enzymes etc. let us now talk about these changes in detail.

A. Color

Color factors in food such as anthocyanins, carotenoids, chlorophyll etc, are affected by heat. In some cases, the color changes that take place in food on cooking are desirable while in some other cases the changes may be undesirable. The cooking condition should be so organized as to obtain the desired color qualities in the cooked food.

Chlorophyll: is the green pigment present in green plants, is not much affected by the heat. The color of the green leafy vegetables is changed to olive green and then to the brown in the long run, especially when the medium of cooking is acidic i.e. in the presence of little vinegar or lemon juice. To maintain the good color of green leafy vegetables, it is advisable to cook them uncovered or leaving the pan uncovered for the first few minutes of cooking.

Carotenoids: This is the yellow orange color pigment found in yellow, orange, and red colored vegetables and fruits, like papaya, carrot, tomato, and green leafy vegetables etc. this pigment remains unaffected by heat or acidic medium but turns slightly blue in alkaline medium. Thus, the color of the vegetables and fruits containing carotene remains unchanged on cooking.

Anthocyanins: This pigment is responsible for the red, magenta, or purple color of vegetables and fruits. It is found in black carrots, jamun, phalluses, beetroot, skin or brinjal etc. heat has no marked effect on this pigment.

Flavones: This is the white pigment present in vegetables like potato, cauliflower, onion etc. This is also not much affected by heat or acidic medium, only alkaline medium makes it turn yellowish in color.

Thus, we see that usual cooking medium generally does not alter the natural color of vegetables and fruits, but if cooked in acidic or alkaline medium, it can be adversely affected, hence we should avoid the use of any acid alkali during cooking.

B. Texture: Cooking in general affects the texture of all foodstuffs. The cellulose present in them becomes softer and this makes the foodstuffs also softer for example, cooked vegetables are much softer than raw. The starch granules present in the raw foodstuffs get gelatinized in the presence of moist heat i.e. when they are cooked in the presence of water, they absorb water and swell up, thus becoming softer and softer and finally some granules even burst and release the starch into the medium. This makes the foodstuffs easily digestible. Such changes are seen in cooking of pulses, rice, potatoes etc, as they are rich in starches. On cooking, proteins get coagulated, for example egg white, but if overcooked they can become hard and over-cooking also renders the proteins indigestible.

The texture of the food, after cooking is also dependent on the method which is used for cooking. All the moist heat methods i.e. boiling, steaming, pressure cooking and stewing makes the foodstuffs soft and tender.

C. Flavor and Taste: The natural flavors and taste of the food is somewhat changed after cooking. However, the flavor and taste can be made to cater to one's taste buds with the help of appropriate spices and condiments. The spices and other flavoring agents used while preparing food and combination of the natural flavors and taste of the foodstuffs imparts a characteristic flavor and taste to the cooked food.

D. Nutrients:*Carbohydrates:* Starch, sugar, gums, cellulose are important carbohydrate found in foods. On cooking the starch granules in foods swell as they absorb water. This process is called gelatinization and is in fact the reason for the thickening of soups, curries, stews to which corn flour paste is added. Gelatinization takes place in all starch containing foods such as potatoes on heating in the presence of moisture.

Dry heat causes the starch to break down into smaller molecules called dextrins. Dextrin's have a mildly sweet flavor. Sugar on heating from syrup with water

Proteins: Proteins harden and solidify or coagulate on cooking. The liquid sets on heating and becomes solid. This is the process of coagulation. However, milk protein is an exception. Unlike other proteins it does not coagulate. Excessive heating of foodstuffs also affects the nutritive value of proteins. Sugars like glucose and lactose form complexes with ammo acids like lysine. Some pulses like soya bean and Bengal gram contain certain substances which hinder the digestion of the proteins of these foods by the enzyme trypsin present in our intestines. During cooking these trypsin inhibitors are destroyed.

Fats & Oils: Ordinary cooking has no effect on fat, but prolonged heating, as in the case of frying for long periods thickens and darkens the fat. A part of essential fatty acids present in fat are destroyed and toxic polymerized products are formed. These changes are accompanied by changes in flavor also, which may not be acceptable. Fats and oils, become rancid by action of air (oxidized) water (hydrolysis) and enzymes. These changes must be minimized, so that the food in which fat is used remains acceptable.

Minerals: There is no loss of minerals in normal cooking procedures. If cooking water is discarded (a small fraction) water soluble minerals may be lost.

Vitamins: Thiamin and Vitamin C are two vitamins, which are most affected by cooking. The losses may occur due to dissolved nutrients being discarded. Discarding the cooking water accounts for a loss of nearly 20-25 per cent of thiamin depending on the quantity of water used in cooking. If sodium bicarbonate is added to pulses during cooking, most of the thiamine is destroyed.

Vitamin C is the most liable vitamin lost during washing vegetables after cutting, exposing cut vegetables to air for long periods before cooking and/or serving and leaching of vitamin C in the cooking water which is later discarded, amounts to a loss of 10% to 60% depending on the vegetables cooked and the method of cooking used.

Loss of riboflavin during cooking occur in four ways (i) exposure of the food during cooking to strong light, (ii) loss of riboflavin due to heat (iii) loss of riboflavin due to leaching by discarding excess of cooking water and (iv) loss of riboflavin due to addition of cooking soda during cooking of dale and vegetables. Bottled milk exposed to strong sunlight losses a part of riboflavin present. Loss of other water-soluble vitamins is mainly due to heat or loss in water.

Vitamin A and Carotene are insoluble in water, so no loss occurs by discarding cooking water. There is slight destruction of vitamin A and carotene during cooking

in water due to oxidation by air. Frying, baking, roasting and toasting causes considerable losses of vitamin A and Carotene.

UNIT - V

Classification of modified diets

I. The diet is normally modified in the following ways

1. Modification in consistency- clear liquid, full liquid, soft, mechanical soft, light, pureed and bland.

2. Modification in nutrient content - High protein, low protein, sodium restricted, low fat high fiber.

3. Modification in quantity - Obesity, vomiting, diarrhea, diabetes

4. Modification in method of feeding - Eternal and parental

Clear fluid diet – The clear fluid diet is used for short periods when there is acute vomiting or diarrhea, when minimal bowel residue is desired and to test the individual's ability to tolerate oral food. This diet is free from any solids, even those found in milk. The clear fluid diet is inadequate in all nutrients and should be used only for 1-2 days. The main purpose of this diet is to prevent dehydration and relieve thirst. It is high in simple sugars and needs to be modified for diabetic individuals. The amount of fluid given initially is 40-80 ml/hr. which is gradually increased to 100-120 ml/hr. foods included:

1. Fruit juices – apple, orange, grapes
2. Cereal water – barley water, arrowroot water, sago, rice kanji
3. Soups – clear consommé, fat free broth
4. Beverages – tea, coffee, lime juice, coconut water
5. Flavored gelatin and fruit ices.

Full liquid diet – This diet is prescribed for individuals who are unable to chew, swallow or tolerate solid foods. It is given after the clear liquid diet and before starting solid foods.
It is composed of foods that are liquid at room temperature. If it is well planned it can meet most of the RDAs. However due to difficulty in consuming adequate amounts of foods from the body building and cereal food groups. Vitamins and mineral supplements should be given if the diet is to be used for longer duration. It is prescribed during acute infections, gastritis, and diarrhea when milk is permitted after surgery.
Foods included:

1. Cream soups, dale soup, whipped potatoes
2. Eggnog, milkshakes, plain ice cream
3. Oatmeal, arrowroot, and sago kanji with milk
4. Soya milk, health drinks lassie.

Soft diet: It is given during convalescence, acute infection, gastrointestinal disorders, and after surgery.
The foods include in this diet are soft in texture and consistency, easy to chew and digest with very little fiber, spices, and condiments. Spicy, highly seasoned and fried foods are avoid as they may cause heartburn, belching and indigestion. Strongly flavored vegetables and gassy foods can cause discomfort because of flatus or gas produced by bacterial fermentation of indigestible carbohydrates.

Foods included – a wide variety of foods from the basic food groups can be selected and a nutritionally adequate diet can be planned. Cooking methods should be boiling, steaming, poaching, and stewing. Fruits and vegetables with coarse skins, rough fibers and seeds guava, jackfruit should be avoided. Strongly flavored vegetables such as cabbage, cauliflower, onions, Bengal gram, fried eggs, omelets all salads sweet, meat and masalas and pickles should be avoided.

Mechanical soft diet – This is also called a dental diet and is a variation of the soft diet. It includes foods which are easy to chew and swallow. There is no restriction on seasoning or method of preparation. The texture of food may be modified be mechanical processing such as mashing, blender zing, and chopping. This diet is nutritionally adequate if full planned and is given to individuals who have difficulty in chewing or swallowing because of teeth and gum problems.

Pureed diet- This is given to individuals who have difficulty in chewing and swallowing food. It includes all liquid and semi-liquid foods which require no mastication.

1. Milk and milk beverages
2. All fruit and vegetable purees and juices
3. Soft scrambled egg, boiled mashed dales
4. Soft, cooked cereals and oatmeal.

NEUTRACEUTICALS

The word neutraceuticals originates from the word `nutrition' and `pharmaceuticals'. It implies the usage of food as protective drugs or as food supplements. Some of the most common ways of classifying nutraceuticals can be based on food sources, mechanism of action, chemical nature etc. The food sources used as nutraceuticals are all natural and can be categorized as:

1. Dietary Fiber
2. Probiotics
3. Prebiotics
4. Polyunsaturated fatty acids
5. Antioxidant vitamins
6. Polyphenols
7. Spices

1. Dietary fiber: Dietary fiber is the food material, more precisely the plant material that is not hydrolyzed by enzymes secreted by the digestive tract, but digested by micro flora in the gut. Dietary fibers mostly include non-starch polysaccharides (NSP) such as celluloses, hemicelluloses, gums and pectin's, lignin, resistant dextrin's and resistant starches.

Foods rich in soluble fiber include fruits, oats, barley and beans. Chemically dietary fiber means carbohydrate polymers with a degree of polymerization not lower than 3, which are neither digested nor absorbed in the small intestine. Based on their water solubility, dietary fibers may be divided into two forms: -

1. Insoluble dietary fiber (IDF), which includes celluloses, some hemicelluloses and lignin's which is fermented to a limited extent in the colon.
2. Soluble dietary fiber (SDF), which includes β-glucans, pectin's, gums, mucilage's and hemicelluloses that are fermented in the colon.

The IDF and SDF compounds are collectively known as non-starch polysaccharides (NSP).

2.Probiotics: A probiotic can be defined as live microbial feed supplement, which when administered in adequate amounts beneficially affects the host animal by improving its intestinal microbial balance. *Probiotics are live bacteria or yeasts when ingested in adequate amount provides health benefits. There are always two types of bacteria in our body – good bacteria and bad bacteria. Probiotics are good bacteria that help to restore the natural balance of bacteria in your gut when it is disrupted. You can get probiotics from various supplements as well as from foods prepared by bacterial fermentation.*

There are so many types of probiotics, but these are some specific types of bacteria that are common probiotics. These include.

1. Lactobacilli such as *L. acidophilus*, *L.casei,*
2. Gram-positive cocci such as *Lactococcus*, *Streptococcus, Enterococcus.*
3. Bifidobacteria such as *B.bifidun*, *B.adolescentis*

Some probiotics are prepared from yeast also named as –

4. *Saccharomyces boulardii*

Probiotics are available in various forms as powder form, liquid form, gel or paste or granule forms, capsule forms etc. Specific probiotics are generally used to treat gastrointestinal (GI) conditions such as lactose intolerance, acute diarrhea, and antibiotic-associated GI side effects. Probiotic agents possess the properties of non-pathogenic, non-toxic, resistance to gastric acid, adherence to gut epithelial tissues producing antibacterial substances. There isevidence that administration of probiotics decreases the risk of systemic conditions, such as allergy, asthma, cancer and several other infections of the ear, urinary tract.

Source of Probiotic food: Yogurt, butter milk, pickles, kombucha, kimchi, sauerkraut, cheese, and kefir.Yogurt is one of the best and easily available sources of probiotics.Pickles are the traditional form of probiotics.Kombucha is a fermented drink made with black or green tea and a symbiotic culture of bacteria and yeast.Kimchi is a fermented food rich in probiotics that provide a wide range of health benefits.Sauerkraut is a

fermented cabbage which boosts the healthy flora in the guts, raise your immune system, and even improves your overall health. Kefir is a fermented probiotic milk drink made by adding kefir grains to cow's or goat's milk.

Functions of Probiotics:

1. Probiotics Help Balance the Friendly Bacteria in Your Digestive System. Probiotics include "good" bacteria. These are live microorganisms that can provide health benefits when consumed.

2. They Can Help Prevent and Treat Diarrhea

3. Probiotic Supplements Improve Some Mental Health Conditions

4. May help keep your heart healthy by lowering LDL ("bad") cholesterol and blood pressure.

5. May Reduce the Severity of Certain Allergies and Eczema in children and infants.

6. They Can Help Reduce Symptoms of Certain Digestive Disorders

7. May Help Boost Your Immune System a boost and inhibit the growth of harmful gut bacteria and reduce the risk of urinary tract infections (UTIs) in women by 50%.

8. May helps with weight loss and Belly fat through several different mechanisms.

3. Prebiotics

Prebiotics are naturally occurring, non-digestible food components that are linked to promoting the growth of helpful bacteria in your gut. Simply said, they are "good" bacteria promoters. That is right, not all bacteria are bad! Prebiotics may improve gastrointestinal health as well as potentially enhance calcium absorption.Prebiotics are dietary ingredients that beneficially affect the host by selectively altering the composition or metabolism of the gut micro biota. These are short-chain polysaccharides that have unique chemical structures that are not digested by humans; fructose-based oligosaccharides that exist naturally in food

or are added in the food. The prebiotic consumption generally promotes the Lactobacillus and Bifidobacterial growth in the gut, thus helping in metabolism.

Vegetables like chicory roots, banana, tomato, alliums are rich in fructo-oligosaccharides. Some other examples of these oligosaccharides are raffinose and stachyose, found in beans and peas.

Source of food: Chicory roots, dandelion greens, garlic, onions, asparagus, bananas, barley, oats, apples, flaxseeds, yacon root, wheat bran and cocoa are the good sources of prebiotics.

The health benefits of the prebiotics include improved lactose tolerance, antitumor properties, neutralization of toxins, and stimulation of intestinal immune system, reduction of constipation, blood lipids and blood cholesterol levels. Maintain an optimal pH in the intestine. Reduce the formation of gases. Stimulate peristalsis. Improve the work of the digestive system. Stimulate the growth and reproduction of only useful microflora.

Polyunsaturated fatty acids(PUFA): PUFAs are also called “essential fatty acids” as these are crucial to the body’s function and are introduced externally through the diet PUFAs have two subdivisions: omega-3- (n-3) fatty acids and omega-6-(n-6) fatty acids. The major omega-3-fatty acids are α-linolenic acid (ALA), eicosapentanoic acid (EPA), docosahexanoic acid (DHA).. EPA and DHA are found mainly in fatty fishes such as mackerel, salmon, herring, trout, blue fin tuna and in fish-oils.

Principal sources of ALA are mainly flaxseed, soybeans, canola, some nuts (e.g. walnuts) and red/black currant seeds. Omega-6-PUFAs mainly consist of linoleic acid (LA), γ-linolenic acid (GLA) and arachidonic acid (ARA). LA occurs mainly in vegetable oils e.g. corn, safflower, soya bean and sunflower. ARA is found in animal products such as meat, poultry, and eggs.

Studies suggest that omega-3-fatty acids have three major effects as cardiovascular diseases anti-arrhythmic. the benefits of omega-3-oils in other areas of health including pre-mature infant health, asthma, bipolar and depressive disorders, Omega-3-fatty acids have been shown to be beneficial at various stages of life.

5. AntioxidantVitamins

Vitamins like vitamin C, vitamin E and carotenoids are collectively known as antioxidant vitamins. These vitamins act both singly as well as synergistically for the prevention of oxidative reactions leading to several degenerative diseases including cancer, cardiovascular diseases, cataracts etc. These vitamins are abundant in many fruits and vegetables and exert their protective action by free-radical scavenging mechanisms.

Vitamin E which comprises of tocopherols together with tocotrienols transfer hydrogen atom and scavenge singlet oxygen and other reactive species thus protecting the peroxidation of PUFA within the biological membrane and LDL. Vitamin E and selenium has a synergistic role against lipid peroxidation. Vitamin C, better known as ascorbic acid, donates hydrogen atom to lipid radicals, quenches singlet oxygen radical and removes molecular oxygen. Scavenging of aqueous radicals by the synergistic effect of ascorbic acid along with tocopherol supplementation is a well-known antioxidant mechanism. Carotenoids like lycopene, β-carotene, lutein, zeaxanthin are known to be the most efficient singlet oxygen quencher in the biological systems without the production of any oxidizing products. β-carotene traps peroxy free radicals in tissues at low oxygen concentrations.

6. Polyphenols: Polyphenols form a large group of phytochemicals, which are produced by plants as secondary metabolites to protect them from photosynthetic stress, reactive oxygen species. There are approximately 8,000 different classes of polyphenols, the most important being flavonols, flavones, flavan-3-ols, flavanones and anthocyanins. The most commonly occurring polyphenols in food include flavonoids and phenolic acids. Dietary polyphenols that they can affect numerous cellular processes like, gene expression, apoptosis, platelet aggregation, intercellular signaling, that can have anti-carcinogenic and anti-atherogenic implications. Legumes also supply the diet with polyphenols like flavonoids, isoflavones and **lignans.** Of all legumes, soyabean has received most attention. Soyabean is most significant source of dietary isoflavones.

Spices

Spices are esoteric food adjuncts that are used for thousands of years to enhance the sensory quality of foods. These impart characteristic flavor, aroma, or piquancy and color to foods, stimulating our appetite as well as modify the texture of food. Recent research reveals that dietary spices in their minute quantities has an immense influence on the human health by their antioxidative, chemo preventive, antimutagenic, anti-inflammatory, immune modulatory effects

on cells and a wide range of beneficial effects on human health by the action of gastrointestinal, cardiovascular, respiratory, metabolic, reproductive, neural and other systems.

MODIFIED FOODS

Bio-technology centers on the microbes and cells taken from plants and animals and their ability to synthesize wide range of valuable substances. The important area of bio-technology application is the qualitative improvement in foods.

The principle governing genetic engineering is that genetic material which is also known as DNA can be transferred from a cell of one species to another unrelated species to express itself in the recipient cells. This is also known as recombinant DNA technology.

Foods modified through the transfer of genes are known as Genetically Modified Foods (GM Foods).

Advantages of GM Technology:

1. It is much faster and cheaper and allows a greater precision in selecting desirable characteristics when compared to traditional breeding techniques.
2. It gives rise to pest and virus resistant crops.
3. Nutritional improvement-Genes that control desired micronutrients can be transferred to obtain new crops with increased vitamin and mineral content.

   The introduction of genetically modified crops with increased vitamin and mineral content is of great importance owing to the prevalence of nutrient deficiencies around the world. Iron - rich rice, quality protein-maize, high carotene-sweet potato and micronutrient rich seeds are some of the outcomes of research in food biotechnology. In our country genetically modified rice, potatoes and tomatoes are under experimentation. The golden rice with enhancement of vitamin A is an example.
4. Adaptive to harsh conditions – Genetic modification enables crops to grow in harsh conditions like drought and temperature extremes.

FOOD LAWS AND STANDARDS

Prevention of Food Adulteration Act.

The prevention of Food Adulteration Act, (PFA) 1954 operated by the Directorate General of Health Services, Ministry of Health was designed for the following purposes:

1. It formulates and monitors the standard of quality and purity of foods with emphasis on prevention of adulteration of foods.
2. It is the basic structure intended to protect the common consumer against the supply of adulterated foods.
3. It makes provision for prevention of adulteration of food and lays down the rule that no person shall manufacture for sale, store, sell or distribute any adulterated or misbranded food or food which contravenes the provision of act or rules.
4. It has set the yardstick to ascertain adulteration.

According to this act, a food is deemed to be adulterated – if:

1. It is not of the nature, substance, and quality, which the food ought to be.

1. It contains any other substance which affects, or if the article is so processed to affect injuriously the nature, substance, and quality of the food.

2. It contains added inferior or cheaper substance that affects the nature and quality of the food.

3. Any constituent of the food is removed to affect injuriously the nature, quality, and substance of the food.

4. It is prepared, packed, and stored under unsanitary conditions It contains any filthy, disgusting, rotten, decomposed substance of a diseased animal or vegetable substance or is insect-infested or otherwise unfit for human consumption.

5. The article is obtained from a diseased animal.

6. The article contains a poisonous ingredient or any other ingredient injurious to health.

7. The container renders the food injurious to health.

8. It contains excessive or prohibited colors.

9. It contains excessive or prohibited preservatives.

10. It does not satisfy the standards prescribed by the authorities

Under the provision of the PFA Act, the Government of India has promulgated PFA rules which specify the following details:

1. Qualification, duties and functions of food analysts, food inspectors and central food laboratory.
2. Procedure for drawing test samples and sending them to the analyst and laboratory.
3. Specification for the identity and purity of food.

4. Tolerance for contaminants, preservatives, emulsifiers, and other additives

Agmark Standard:

The word Agmark is derived from the words 'Agricultural Marketing'. It is a standard of quality based on the physical and chemical characteristics of food, both the natural and those acquired during processing.

Products graded under AGMARK include vegetable oils, ghee, butter, rice, groundnut, pulses, and spices. These standards ensure accurate weight and correct selling price.

Bureau of Indian Standards:

The Bureau of Indian Standards lays down criteria for standardization of vegetables and fruit products, spices and condiments, animal products and processed food.

Manufacturers can use the BIS label on each unit of their product, if their products conform with the standards laid down by BIS. The products are checked for quality by laboratories certified by BIS. BIS is also known as ISI (Indian Standard Institution).

Some of the items which require compulsory BIS certification under PFA Act include artificial food colors, natural food colors, food additives, infant formula; milk-cereal based weaning foods, milk powder and condensed milk.

Phytochemicals:

Phytochemicals are compounds that are produced by plants ("phyto" means "plant"). They are found in fruits, vegetables, grains, beans, and other plants. Some of these phytochemicals are believed to protect cells from damage that could lead to cancer. Phytochemicals are a large group of non-nutrient secondary metabolites present in vegetables and fruits. A few of the well-known phytochemicals are generally grouped into the alkaloids, terpenoids, and phenolic compounds. Among all phenolic compounds, the most common phytochemical includes flavonoids, phenolic acids, and polyphenols. well-known phytochemicals are the flavonoids, phenolic acids, isoflavones, curcumin, isothiocyanates, and carotenoids. The many phytochemicals in common plant foods, herbs, and spices. Phytochemicals are classified as polyphenols, terpenoids, alkaloids, phytosterols, and organosulfur compounds a broad range of chemical compounds

Some scientists think that you could reduce your cancer risk by as much as 40% by eating more vegetables, fruits, and other plant foods that have certain phytochemicals in them. Research has shown that some phytochemicals may:

- help stop the formation of potential cancer-causing substances.
- help stop carcinogens from attacking cells.
- help cells stop and wipe out any cancer-like changes.

Some of the most beneficial phytochemicals are:

- beta carotene and other carotenoids in fruits and vegetables
- resveratrol in red wine
- polyphenols in tea
- isothiocyanates in cruciferous vegetables - cabbage, broccoli, brussels sprouts, mustard greens, turnip greens, and cauliflower.

Because these phytochemicals are in the fruits, vegetables, beans, and grains you eat, it iseasy to include them in your diet. A carrot, for example, has more than 100 phytochemicals. Keep in mind that there is no evidence that taking phytochemical supplements is as good for you as eating the whole fruits, vegetables, beans, and grains that contain them. Most experts strongly believe that it is the combination of these compounds and the other foods you eat that keeps your body healthy. Loading up on one or two phytochemicals in pill form probably will not be as beneficial as eating a balanced diet with a variety of foods that includes 5 or more cups of fruits and vegetables per day and food from other plant sources, such as whole-grain breads, cereals, nuts, seeds, rice and pasta, and beans.

There are several main groups of health-promoting phytochemicals.

Flavonoids are found in lots of grains, vegetables, and fruits. The flavonoids in soybeans, chickpeas, and licorice may act a little bit like estrogen, a hormone that might affect the risk of breast cancer that depends on estrogen for its growth.

The estrogen-like compounds in these plants are called phytoestrogens. But most phytoestrogens have very weak estrogen-like activity. When a weak estrogen-like substance replaces your body's natural estrogen's position, then the weak substance can act as a relative anti-estrogen.

Antioxidants protect your body's cells from free radicals — unstable molecules created during normal cell functions. Pollution, radiation, cigarette smoke, and herbicides also can create free radicals in your body. Free radicals can damage a cell's genetic parts and may trigger the cell to grow out of control. These changes may contribute to the development of cancer and other diseases.

Antioxidants are found in broccoli, brussels sprouts, cabbage, cauliflower, tomatoes, corn, carrots, mangos, sweet potatoes, soybeans, oranges, spinach, nuts, lettuce, liver, fish oil, seeds, grains, kale, beets, red peppers, potatoes, blueberries, strawberries, and black and green tea. As a rule, dark-colored fruits and vegetables have more antioxidants than other fruits and vegetables.

Carotenoids, which give carrots, yams, cantaloupe, squash, and apricots their orange color, may help reduce the risk of cancer.

Anthocyanins, which give grapes, blueberries, cranberries, and raspberries their dark color, have been shown in the laboratory to have anti-inflammatory and anti-tumor properties.

Sulfides, found in garlic and onions, may strengthen the immune system.

Registered dietitians and other healthcare professionals will always recommend eating a balanced diet that includes a variety of vegetables, fruits, legumes, and whole grains.