Women University Press
Jayoti Publication Desk
ISBN No. : 978-93-90892-68-6

PRINCIPLES OF FOOD SCIENCE AND NUTRITION

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
UGC Approved Under 2(f) & 12(b) | NAAC Accredited | Recognized by Statutory Councils

Printed by :
JAYOTI PUBLICATION DESK

Published by :
Women University Press
Jayoti Vidyapeeth Women's University, Jaipur

Faculty of Agriculture & Veterinary Science

Title: Principles of Food Science and Nutrition
Author Name: Ms. Sakshi Pandey

Published By: Women University Press

Publisher's Address: Jayoti Vidyapeeth Women's University, Jaipur
Vedant Gyan Valley,
Village-Jharna, Mahala Jobner Link Road, NH-8
Jaipur Ajmer Express Way,
Jaipur-303122, Rajasthan (India)

Printer's Detail: Jayoti Publication Desk

Edition Detail:

ISBN: 978-93-90892-68-6

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CHAPTER 1
CONCEPT OF FOOD SCIENCE

INTRODUCTION:

The word food brings to our mind countless images. Food is associated with worship and divinity; with celebration and mourning; with family gatherings and with community feasting. It is closely interwoven with every feature of our existence. This is not surprising because food plays a crucial role in our lives. It sustains us. it nourishes us. It is the 'life-giver". This unit tells you about food and some of its components. It will give you some idea about why food is essential for our survival. You will also be introduced to the terms nutrition and health. Nutrition is the term used for the scientific study of food and how it is utilized by the body. Eating the proper kinds of food in the right amounts is essential to keep us healthy. In other words, our health is dependent on our eating pattern. This leads US to the vital question-how much and what should one eat to keep healthy? How much and what, for example, should an infant consume? Similarly, how much and what foods should be consumed by a child, an adolescent, an adult or an old person? Further, what happens when one eats too much or too little?

Food istherefore, a complex. Mixture of different nutrients and non-nutrients

FUNCTIONS OF FOOD: You are now. Familiar with the fact that food consists in part of various-nutrients. You may be surprised to know that there are over forty essential nutrients, which are supplied by the food we eat. These nutrients can k classified into five major categories (based on certain similar features): proteins, carbohydrates, fats, vitamins and minerals. Water is important as a nutrients as well as a food.

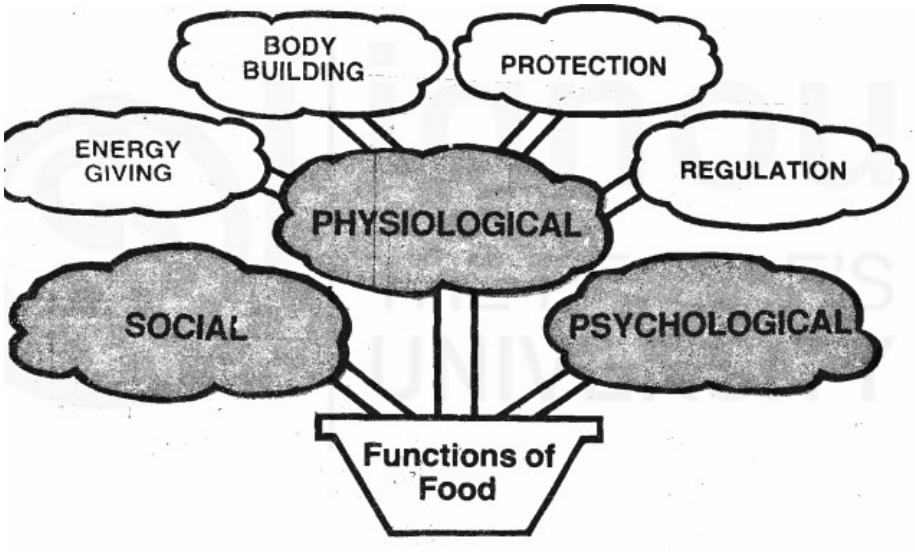

Fig 1: Functions of foods (source: food, nutrition & health)

MEANING OF NUTRITION:

Nutrition is a .science discipline with food as the major focus of interest. The simplest definition of nutrition can be expressed thus: "the study of what B happens to food once it enters the mouth and thereafter." However, a more detailed definition would be : "the science of foods, the nutrients and other substances therein; 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 products. In addition, nutrition must be concerned with the social, economic, cultural and psychological implications food and eating.

THE CONCEPT OF HEALTH

We are all familiar with the term "health". What does his term mean'? Let us consider the definition of health proposed by the World Health Organisation (WHO):

"Health is a state of complete phvsical, mental and social well-being and not merely the absence of disease or infirmity."

DIMINSION OF HEALTH

- **Physical health:** The physical dimension of health is familiar to us. When we say a person is healthy. we are generally referring to this aspect. Physical health is easy to detect and descry.
- **Mental health:** Mental health implies freedom from internal conflicts, no consistent tendency to condemn or pity oneself, a good capacity to adjust to situations and people, sensitivity to the emotional needs of others capacity to deal with other individuals with consideration and courtesy, good control over one's own emotions without constantly giving in to strong 'feelings of fear, jealousy. anger or guilt.
- **Social health:** If an individual rec'ognizes that he/ she belongs to a family and is'able to identify with a wider community. the first step towards social health has - been taken. An individual who recognixs his/ her obligations towards other members of society and is able to relate to other people around him/ her can be described as socially healthy.
- **Spiritual health:** ing good and of not harming others; of believing in the basic forces of goodness and justice whether or not thkse are worshipped as God; of recognizing the needs of others and trying to fulfil them; of commitment. duty and obligation, these are all characteristics of a spiritually well person.

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

- The word nutrient or “food factor” is used for specific dietary constituents such as proteins, vitamins and minerals. Dietetics is the practical application of the principles of nutrition; it includes the planning of meals for the well and the sick. Good nutrition means “maintaining a nutritional status that enables us to grow well and enjoy good health.”

- Protein, carbohydrate and fat had been recognized early in the 19th century as energyyielding foods and much attention was paid to their metabolism and contribution to energy requirements.

Questions:

1. Define nutrition and give its meaning.
2. What is concept of health, explain its dimensions.

References

1. Abdrin Z and Abrol Y. Traditional system of medicines. Indian Journal of . Medical Sciences.2012; 4(67);87-98.
2. Adams B, HallogenMandPutanK.swertiachirata leaves used as a flavoured ingredient in the chips. Indian Journal of Food Technology.2013;7(9):89-90.

CHAPTER 2

CLASSIFICATION OF FOODS

- Classification by origin: - Foods of animal origin - Foods of vegetable origin
- Classification by chemical composition: - Proteins – Fats – Carbohydrates – Vitamins – Minerals
- Classification by predominant function
- Body building foods: meat, milk, poultry, fish, eggs, pulses etc
- Energy giving foods: cereals, sugars, fats, oils etc.
- Protective foods: vegetables, fruits, milk, etc
- NUTRIENTS
- Organic and inorganic complexes contained in food are called nutrients. They are broadly divided in to:
- Macronutrients: proteins, fats, carbohydrates
- Micronutrients: vitamins, minerals
- PROTEINS
- Proteins are complex organic nitrogenous compounds.
- They also contain sulfur and some cases phosphorous and iron.
- Proteins are made of monomers called amino acids.
- There are about 20 different aminoacids which are found in human body of this 8 aa are termed “essential” as they are not synthesized in human body and must be obtained from dietary protiens.
- Functions of Proteins
- Body building
- Repair and maintenance of body tissues
- Maintenance of osmotic pressure
- Synthesis of bioactive substances and other vital molecules
- Evaluation of proteins The parameters used for net protein evaluation are:
- Biological value
- Digestibility coefficient
- Protein efficiency ratio
- Net protein utilization (NPU)
- Assessment of Protein nutrition status
- Protein nutrition status is measured by Serum Albumin Concentration.
- It should be more than 3.5 g/dl.
- Less than 3.5 g/dl shows mild malnutrition.
- Less than 3.0 g/dl shows severe malnutrition.

Nutritional aspect of protein

High-protein, low-carbohydrate diets are the hottest thing since sliced flank steak, and every food marketer in the known universe appears to want a piece of the protein pie.

Body builders are snatching, grabbing, and gulping down protein shakes. Dieters are gobbling down protein bars (and shunning pasta) in hopes of quick weight loss.

The Power of Protein

It's easy to understand the excitement. Protein is an important component of every cell in the body. Hair and nails are mostly made of protein. Your body uses protein to build and repair tissues. You also use protein to make enzymes, hormones, and other body chemicals. Protein is an important building block of bones, muscles, cartilage, skin, and blood.

Along with fat and carbohydrates, protein is a "macronutrient," meaning that the body needs relatively large amounts of it. Vitamins and minerals, which are needed in only small quantities, are called "micronutrients." But unlike fat and carbohydrates, the body does not store protein, and therefore has no reservoir to draw on when it needs a new supply.

1. **Growth and Maintenance**

2. Your body needs protein for growth and maintenance of tissues.

3. Yet, your body's proteins are in a constant state of turnover.

4. Under normal circumstances, your body breaks down the same amount of protein that it uses to build and repair tissues. Other times, it breaks down more protein than it can create, thus increasing your body's needs

2. Causes Biochemical Reactions

Enzymes are proteins that aid the thousands of biochemical reactions that take place within and outside of your cells.

The structure of enzymes allows them to combine with other molecules inside the cell called substrates, which catalyze reactions that are essential to your metabolism.

Enzymes may also function outside the cell, such as digestive enzymes like lactase and sucrose, which help digest sugar.

Some enzymes require other molecules, such as vitamins or minerals, for a reaction to take place. Bodily functions that depend on enzymes include:

- Digestion
- Energy production
- Blood clotting
- Muscle contraction

3. Acts as a Messenger

Some proteins are hormones, which are chemical messengers that aid communication between your cells, tissues and organs. They're made and secreted by endocrine tissues or glands and then transported in your blood to their target tissues or organs where they bind to protein receptors on the cell surface.

Hormones can be grouped into three main categories

- **Protein and peptides:** These are made from chains of amino acids, ranging from a few to several hundred.
- **Steroids:** These are made from the fat cholesterol. The sex hormones, testosterone and estrogen, are steroid-based.
- **Amines:** These are made from the individual amino acids tryptophan or tyrosine, which help make hormones related to sleep and metabolism.

Protein and polypeptides make up most of your body's hormones.

4. Provides Structure

Some proteins are fibrous and provide cells and tissues with stiffness and rigidity.

These proteins include keratin, collagen and elastin, which help form the connective framework of certain structures in your body

5. Maintains Proper pH

Protein plays a vital role in regulating the concentrations of acids and bases in your blood and other bodily fluids

6. Balances Fluids

Proteins regulate body processes to maintain fluid balance.

Albumin and globulin are proteins in your blood that help maintain your body's fluid balance by attracting and retaining water

If you don't eat enough protein, your levels of albumin and globulin eventually decrease.

Consequently, these proteins can no longer keep blood in your blood vessels, and the fluid is forced into the spaces between your cells.

As the fluid continues to build up in the spaces between your cells, swelling or edema occurs, particularly in the stomach region

8. Transports and Stores Nutrients

Transport proteins carry substances throughout your bloodstream — into cells, out of cells or within cells.

The substances transported by these proteins include nutrients like vitamins or minerals, blood sugar, cholesterol and oxygen

9. Provides Energy

Proteins can supply your body with energy.

Protein contains four calories per gram, the same amount of energy that carbs provide. Fats supply the most energy, at nine calories per gram.

However, the last thing your body wants to use for energy is protein since this valuable nutrient is widely used throughout your body.

Carbs and fats are much better suited for providing energy, as your body maintains reserves for use as fuel. Moreover, they're metabolized more efficiently compared to protein.

Questions:

1. Give the classification of food, explain briefly

2. What are proteins? Give its nutritional aspects.

References:

1. Abdrin Z and Abrol Y. Traditional system of medicines. Indian Journal of Medical Sciences.2012; 4(67);87-98.
2. Adams B, HallogenMandPutanK.swertiachirata leaves used as a flavoured ingredient in the chips. Indian Journal of Food Technology.2013;7(9):89-90.

CHAPTER 3

FAT

- Most of the body fat (99 per cent) in the adipose tissue is in the form of triglycerides, in normal human subjects, adipose tissue constitutes between 10 and 15 per cent of body weight. One kilogram of adipose tissue corresponds to 7700 kcal of energy.

- Essential fatty acids are those that cannot be synthesized by humans
- Dietary sources of EFA
- Linoleic acid
- Sunflower oil Corn oil Soya bean oil Sesame oil Groundnut oil Mustard oil Palm oil Coconut oil
- Arachidonic acid
- Meat, eggs, milk
- Linolenic acid
- Soya bean oil, Leafy greens
- Functions of fats
- They are high energy foods, providing as much as 9 kcal for every gram.
- Fats serve as vehicles for fat-soluble vitamins. Fats in the body support viscera such as heart, kidney and intestine; and fat beneath the skin provides insulation against cold.

The "non-calorie" roles of fat:

- Vegetable fats are rich sources of essential fatty acids which are needed by the body for growth, structural integrity of the cell membrane and decreased platelet adhesiveness.
- Diets rich in EFA have been reported to reduce serum cholesterol and low density lipoproteins.
- Polyunsaturated fatty acids are precursors of prostaglandins.

Fat requirements: In developed countries dietary fats provide 30 to 40 per cent of total energy intake. The WHO Expert committee on Prevention of Coronary Heart Disease has recommended only 20 to 30 per cent of total dietary energy to be provided by fats. At least 50 per cent of fat intake should consist of vegetable oils rich in essential fatty acids.

Nutritional aspect of fat

1. Provision of energy
   Fats are a source of energy in the human diet, together with carbohydrates and proteins, the other two main macronutrients. Fat is the most concentrated source providing 9 kcal per 1 gram consumed, which is more than double the energy content of protein or carbohydrate (4 kcal per gram) and more than quadruple the energy content of fibre (2 kcal per gram). Fat can

be stored in the body's fat tissue, which releases fatty acids when energy is required (see box: Body fat).

2. Structural component
   The membranes around the cells in our body physically separate the inside from the outside of the cell, and control the movement of substances in and out of the cells. They are mainly made of phospholipids, triglycerides and cholesterol. Both length and saturation of the fatty acids from phospholipids and triglycerides affect the arrangement of the membrane and thereby its fluidity. Shorter chain fatty acids and unsaturated fatty acids are less stiff and less viscous, making the membranes more flexible. This influences a range of important biological functions such as the process of endocytosis in which a cell wraps itself around a particle to allow its uptake.[1]

   The brain is very rich in fat (60%) and has a unique fatty acid composition; docosahexaenoic acid (DHA) is the major brain fatty acid. The lipids of the retina also contain very high concentrations of DHA.[2]

3. Carrier of vitamins
   In the diet, fat is a carrier for the fat-soluble vitamins A, D, E and K, and supports their absorption in the intestine. Consuming sufficient amounts of fatty foods that contain these vitamins is thus essential for adequate intake of these micronutrients.

4. Other biological functions
   Our bodies cannot produce the polyunsaturated fatty acids (PUFA) linoleic acid (LA) and alpha linolenic acid (ALA). Without these essential fatty acids some vital functions would be compromised, thus they must be provided by the diet. LA and ALA can be converted to longer chain fatty acids and compounds with hormone-like or inflammatory properties (such as prostaglandins or leukotrienes, respectively). As such, essential fatty acids are involved in many physiological processes such as blood clotting, wound healing and inflammation. Although the body is able to convert LA and ALA into the long chain versions arachidonic acid (AA), eicosapentaenoic acid (EPA), and, to a lesser extent, to docosahexaenoic acid (DHA), this conversion seems limited.[3] The longer chain fatty acids EPA and DHA are said to be "conditionally essential" and it is recommended to consume direct sources of these particular long chain fatty acids. The richest source of EPA and DHA is oily fish, including anchovy, salmon, tuna and mackerel.

Questions:

1. What is the difference between fat and lipids?
2. What is the nutritional significances of fat?

References:

1. Wertz PW: Essential fatty acids and dietary stress, ToxicolInd Health 25:279, 2009
2. Tazoe H, et al: Roles of short-chain fatty acids receptors, GPR41 and GPR43 on colonic functions, J PhysiolPharmacol 59:251S, 2008

CHAPTER 4

CARBOHYDRATE

- Carbohydrate is the main source of energy, providing 4 Kcals per one gram Carbohydrate is also essential for the oxidation of fats and for the synthesis of certain non-essential amino acids 17 Sources of carbohydrates
- There are three main sources of carbohydrate, viz. starches, sugar and cellulose.
- The carbohydrate reserve (glycogen) of a human adult is about 500g. This reserve is rapidly exhausted when a man is fasting. If the dietary carbohydrates do not meet the energy needs of the body, protein and glycerol from dietary and endogenous sources are used by the body to maintain glucose homeostasis.
- Dietary fibre: Dietary fibre which is mainly non-starch polysaccharide is a physiological important component of the diet. It is found in vegetables, fruits and grains. It may be divided broadly into cellulose and non-cellulose polysaccharides which include hemi-cellulose pectin, storage polysaccharides like inulin, and the plant gums and mucilage. These are all degraded to a greater of lesser extend by the micro flora in the human colon.

Nutritional aspects of carbohydrate

1. ***Carbs Provide Your Body With Energy***

   Glucose in the blood is taken up into your body's cells and used to produce a fuel molecule called adenosine triphosphate (ATP) through a series of complex processes known as cellular respiration. Cells can then use ATP to power a variety of metabolic tasks.

2. ***Carbohydrates Help Preserve Muscle***

   Glycogen storage is just one of several ways your body makes sure it has enough glucose for all of its functions.

   When glucose from carbohydrates is lacking, muscle can also be broken down into amino acids and converted into glucose or other compounds to generate energy.

3. ***They Promote Digestive Health***

   Unlike sugars and starches, dietary fiber is not broken down into glucose.

Instead, this type of carbohydrate passes through the body undigested. It can be categorized into two main types of fiber: soluble and insoluble.

Soluble fiber is found in oats, legumes and the inner part of fruits and some vegetables. While passing through the body, it draws in water and forms a gel-like substance. This increases the bulk of your stool and softens it to help make bowel movements easier.

4. ***They Influence Heart Health and Diabetes***

Certainly, eating excessive amounts of refined carbs is detrimental to your heart and may increase your risk of diabetes.

However, eating plenty of dietary fiber can benefit your heart and blood sugar levels.

As soluble fiber passes through the small intestine, it binds to bile acids and prevents them from being reabsorbed. To make more bile acids, the liver uses cholesterol that would otherwise be in the blood.

Glycemic index

The glycemic index, simply put, is a measure of how quickly a food causes our blood sugar levels to rise.

The measure ranks food on a scale of zero to 100. Foods with a high glycemic index, or GI, are quickly digested and absorbed, causing a rapid rise in blood sugar. These foods that rank high on the GI scale are often — but not always — high in processed carbohydrates and sugars. Pretzels, for example, have a glycemic index of 83.

Meanwhile, foods with a low GI are digested and absorbed at a slower rate, and subsequently, cause a slower rise in blood sugar levels. These are typically rich in fiber, protein and/or fat. Examples of these include apples with a glycemic index of 28, Greek-style yogurt at 11 and peanuts at seven. Keep in mind that a low GI doesn't mean a food is high in nutrients. You still need to choose healthy foods from all five food groups.

Glycemic Index: An Imperfect System, but Useful Tool

A food's GI ranking only applies when a food is consumed on an empty stomach without any other type of food. As anyone who's ever eaten food knows, this isn't always how we eat.

Pair a high GI food with a lean steak or a piece of salmon, a side of broccoli and a salad with vinaigrette, and the protein, fiber and fat all will serve to lower the glycemic index of the meal.

In addition, the glycemic index doesn't take into account how much we're actually consuming. The GI value of a food is determined by giving people a serving of the food that contains 50 grams of carbohydrate minus the fiber, then measuring the effect on their blood glucose levels over the next two hours.

A serving of 50 grams of carbohydrate in one sitting may be reasonable for a food such as rice, which has 53 grams of carbs per cup. But for beets, a GI ranking of 64 is a little misleading since beets have just 13 grams of carbs per cup; we would need to consume nearly 4 cups of beets in order to cause that spike in blood sugar levels.

Glycemic load

An Alternative to Glycemic Index

Glycemic load, or GL, is a formula that corrects for potentially misleading GI by combining portion size and GI into one number. The carbohydrate content of the actual serving is multiplied by the food's GI, then that number is divided by 100. So for a cup of beets, the GL would be: 13 times 64 = 832 divided by 100 = a GL of 8.3.

As a frame of reference, a GL higher than 20 is considered high, between 11 and 19 is considered moderate, and 10 or less is considered low.

The bottom line: Even though the glycemic index isn't a perfect system, it can be a useful tool to identify lower-glycemic foods that often are more nutrient-dense, as well as what foods are higher in refined carbohydrates.

Your blood glucose levels rise and fall when you eat a meal containing carbohydrates. How high it rises and how long it stays high depends on the quality of the carbohydrates (the GI) as well as the quantity. Glycemic Load (or GL) combines both the quantity and quality of carbohydrates. It is also the best way to compare blood glucose values of different types and amounts of foods. The formula for calculating the GL of a particular food or meal is:
Glycemic Load = GI x Carbohydrate (g) content per portion ÷ 100.

For example, a single apple has a GI of 38 and contains 13 grams of carbohydrates.

GL= 38 x 13/100 = 5

A potato has a GI of 85 and contains 14 grams of carbohydrate
GL=85 x14/100 = 12

We can therefore predict that the potato will have twice the glycemic effect of an apple.
Similar to the glycemic index, the glycemic load of a food can be classified as low, medium, or high:
Low: 10 or less
Medium: 11 – 19
High: 20 or more
The GL of a *mixed meal* or diet can simply be calculated by summing together the GL values for each ingredient or component. For example, if breakfast was composed of 2 wheat biscuits (GL = 15), ½ a cup of milk (GL = 4) and 2 teaspoons of sugar (GL = 6), its overall GL would be 25 (15 + 4 + 6).
For the whole day, a low GL diet has a GL less than 100 g/% for people consuming 8,700 kJ. Therefore, for people consuming 3 meals per day, a low GL meal would have a GL ≤ 33 g/%.
For optimal health, you should aim to keep your **daily glycemic load under 100**.

Questions:

1. What is glycemic load and glycemic index of food?
2. What are carbohydrate in food, give its nutritional significances

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1. Arumugam P, Ramamurthy P, Santhia ST and Ramesh A. Antioxidant Activity masured I different solvent Fractions obtained from mint as analysis by ABTS decolorization assay. Journal of Clinical Nutrition.2006;9(02):119-123.
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CHAPTER 5

DIETARY FIBRE AND ITS IMPORTANCE

Dietary fiber, also known as roughage or bulk, includes the parts of plant foods your body can't digest or absorb. Unlike other food components, such as fats, proteins or carbohydrates — which your body breaks down and absorbs, fiber isn't digested by your body. Instead, it passes relatively intact through your stomach, small intestine and colon and out of your body.

Fiber is commonly classified as soluble, which dissolves in water, or insoluble, which doesn't dissolve.

- **Soluble fiber.** This type of fiber dissolves in water to form a gel-like material. It can help lower blood cholesterol and glucose levels. Soluble fiber is found in oats, peas, beans, apples, citrus fruits, carrots, barley and psyllium.
- **Insoluble fiber.** This type of fiber promotes the movement of material through your digestive system and increases stool bulk, so it can be of benefit to those who struggle with constipation or irregular stools. Whole-wheat flour, wheat bran, nuts, beans and vegetables, such as cauliflower, green beans and potatoes, are good sources of insoluble fiber.
  The amount of soluble and insoluble fiber varies in different plant foods. To receive the greatest health benefit, eat a wide variety of high-fiber foods.

IMPORTANCES:

Protection against heart disease – According to the University of Maryland Medical Center, the consumption of soluble fiber has been shown to protect against heart disease by reducing cholesterol levels.

Gastrointestinal health – the consumption of fiber promotes regular bowel movements and prevents constipation. It may also reduce the risk of developing colitis and hemorrhoids. There is also mixed evidence that consuming fiber might help reduce the risk of colon cancer.

Diabetes – people with diabetes who consume a lot of fiber tend to need less insulin than those whose fiber intake is low. Fiber can help slow the absorption of sugar, helping to prevent spikes after meals.

Body weight – a high-fiber intake can significantly contribute toward body-weight control. Fiber produces a feeling of fullness without adding calories (fiber calories are not absorbed by the body) – this can help treat or prevent overweight/obesity.

Most foods that are high in fiber are also very healthy for other reasons. Take, for example, fruit, vegetables, and whole grains; they are high in fiber but also rich in vitamins and other essential nutrients. In other words, eating a high-fiber diet protects health through both the intake of fiber and other essential nutrients.

Functions: Insoluble fiber

Insoluble fibers have many functions, including moving bulk through the digestive tract and controlling pH (acidity) levels in the intestines.

Benefits of insoluble fiber:

- Promotes regular bowel movements and prevents constipation.
- Speeds up the elimination of waste through the colon.
- By keeping an optimal pH in the intestines, insoluble fiber helps prevent microbes from producing substances which can lead to colorectal cancer.

Food sources of insoluble fiber include vegetables – especially dark green leafy ones, root vegetable skins, fruit skins, whole-wheat products, wheat bran, corn bran, nuts, and seeds.

Functions: Soluble fiber

Soluble fiber binds with fatty acids, it slows down the time it takes to empty the stomach and the rate of sugar absorption by the body.

Benefits of soluble fiber:

- Reduces cholesterol, especially levels of low-density lipoproteins (LDL – bad cholesterol).
- Regulates sugar intake, this is especially useful for people with diabetes and metabolic syndrome.
- Soluble fiber is fermented by gut bacteria, improving immune, digestive, and overall health. Good sources of soluble fiber include kidney beans, pinto beans, Brussels sprouts, broccoli,

spinach, zucchini, apples, oranges, grapefruit, grapes, prunes, oatmeal, and whole-wheat bread.

Questions:

1. What are dietary fibre, give its types
2. What are the importance of dietary fibre in our body.

References:

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CHAPTER 6

VITAMINS: FAT SOLUBLE VITAMINS

- Vitamins are a class of organic compounds categorized as essential nutrients. They are required by the body in a very small amounts. They fall in the category of micronutrients.
- Vitamins are divided in to two groups: fat soluble vitamins- A, D, E and K and water soluble vitamins: vitamins of the B-group and vitamin C.

VITAMIN A: Vitamin A covers both a preformed vitamin, retinol, and a pro-vitamin, beta carotene, some of which is converted to retinol in the intestinal mucosa.

- The international unit (IU) of vitamin A is equivalent to 0,2 microgram of retinol (or 0,55 microgram of retinal palmitate).

Functions of Vitamin A

- It is indispensable for normal vision.
- It contributes to the production of retinal pigments which are needed Pro vision lights.
- It is necessary for maintaining the integrity and the normal functioning of glandular and epithelial issue which lines intestinal , respiratory and urinary tracts as well as the skin and eyes.
- It supports growth, especially skeletal growth
- It is anti-intensive.
- It may protect against some epithelial cancers such as bronchial cancers. 22 Deficiency of vitamin A
- The signs of vitamin A deficiency are predominantly ocular.
- They are: ♣Nightblindness♣ Conjunctival xerosis♣Bitot's spots ♣ Corneal xerosis♣Keratomalacia

VITAMIN D

The nutritionally important forms of Vitamin D in man are Calciferol (Vitamin D2) and Cholecalciferol (Vitamin D3).

Functions of vitamin D and its metabolites

- Intestine: Promotes intestinal absorption of calcium and phosphorus
- Bone: Stimulates normal mineralization, Enhances bone reabsorption, Affects collagen maturation
- Kidney: Increases tubular reabsorption of phosphate
- Deficiency of vitamin D Deficiency of vitamin D leads to:
- Rickets
- Osteomalacia

VITAMIN E

- Fat soluble vitamin also known as Tocopherol "a Anti-sterility Vitamin" .
- Functions: Acts as an antioxidant and reduce oxidation of unsaturated fatty acids. Due to anti- neoplastic effect raises the concentration of high density lipids cholesterol. With Vitamin E, selenium plays the role of preventing destruction of lipids by oxidation. Maintains stability of cell membranes. when externally applied would minimize wrinkles, scars and scratch marks.
- Sources of Vitamin E
- Plants based foods: Vegetable oils, hydrogenated fats, dark green leafy vegetables, nuts, whole grain, and legumes. Food rich in polyunsaturated fatty acids are also rich in vitamin E.
- Daily Requirements: Adults: 10 mg (15 IU)
- Deficiency: Deficiency is usually not found as in almost many vegetables foods have Vitamin E.
- Loss of reflexes, ataxia of trunks and limbs, muscle weaknesses.
- Among premature babies, presence of hemolyticanemia.
- Associated with habitual abortion.

VITAMIN K

- Cofactor of enzyme and acts as the catalyst for the formation of prothrombin.
- Two types Phylloquinone – K1 and Manaquinone - K2.
- Vitamin K1 is found in fresh and dark green leafy vegetables where a Vitamin K2 by the synthesis of bacterias in the intestines.
- Destroyed by freezing, by mineral oils and rancid fats.

- Functions:
- Essential Vitamin for the formation of prothrombin.
- Stimulates the production of coagulation factors.
- Synthesize the required protein for the human body.
- Acts as the catalyst for activating the enzyme.
- VITAMIN K Deficiency
- Hemorrhage, bleeding disorders.
- Increased risk of hemorrhage among premature or in the new born babies with complicated labour.
- Daily requirement:
- 0.03 mg/kg body weight for adults.
- Sources:
- Found in fresh green vegetables and fruits. Dark green leafy vegetables, Cabbage, Cauliflower, are richest source. Also found in liver and cow milk.

Questions:

1. What are vitamins? Give its classification.
2. Give the functions of fat soluble vitamins and explain it briefly

References:

1. Arumugam P, Ramamurthy P, Santhia ST and Ramesh A. Antioxidant Activity masured I different solvent Fractions obtained from mint as analysis by ABTS decolorization assay. Journal of Clinical Nutrition.2006;9(02):119-123.
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CHAPTER 7

WATER SOLUBLE VITAMINS

- THIAMINE
- Thiamine (vitamin B1) is a water soluble vitamin. It is essential for the utilization of carbohydrates. Thiamine pyrophosphate (TPP), the coenzyme of cocarboxylase plays a part in activating transkelolase, an enzyme involved in the direct oxidative pathway for glucose. 27 Deficiency of thiamine
- The two principal deficiency diseases are beriberi and Wernick's encephalopathy.
- Beriberi may occur in three main forms: ♣ peripheral neuritis, ♣ cardiac beriberi ♣ infantile beriberi, seen in infants between 2 and 4 months of life. The affected baby is usually breast-fed by a thiamine-deficient mother who commonly shows signs of peripheral neuropathy.
- Wernick's encephalopathy is characterized by ophthalmoplegia, polyneuritis, ataxia and mental deterioration

VITAMIN B2 (RIBOFLAVIN)

- Functions: It involves protein, fat & Carbohydrate metabolism.
- Fundamental role in cellular oxidation.
- Cofactors of various enzymes which plays the metabolism to form the energy.
- Synthesize the glycogen and erythropoiesis which changes the pyridoxines and folic acids to the coenzymes.
- Helps in oxidation of fatty acids and transport H+
- **Sources:**
- Milk and milk products, eggs, liver, green leafy vegetables are good sources.
- Wheat, millet and pulses are fair sources.
- Rice is a poor source. Germinating pulses also furnish riboflavin. Riboflavin is synthesized by bacteria is the large intestine.
- Daily requirement is 1-2 mg or 0.6 mg. per 1000 Kcal intake. Deficiency: confined skin (cracks), and mucosa, glossitis, scaly dermatitis, circumcorneal vascularization and keratitis, photophobia.

VITAMIN B3 (NIACIN)

- Function: It is required by the body for the utilization of carbohydrates and tissue respiration. Essential for normal functions of skin, gastrointestinal and nervous system.
- Helps in synthesis of DNA and its repairment.
- Controls blood cholesterol and lipids.
- Sources: Rich in whole grain cereals, nuts, pulses, meat, liver and chicken, dried yeast, ground nuts. Poor source in maize.

- Daily Requirements: 20 mg. per day or 6.6 mg per 1000 calorie intake.
- Deficiency: gastrointestinal disorder, diarrhoea, loss of appetite, nausea, vomiting, neurological manifestation, loss of memory, pigmented scaly skin, cracks of hand and neck.

VITAMIN B6 ♣ Pyridoxine (vitamin B6) exists in three forms pyridoxine, priodoxal and pyridoxamine. It plays an important role in the metabolism of amino acids, fats and carbohydrate.

- The requirement of adults vary directly with protein intake. Adults may need 2 mg/day, during pregnancy and lactation, 2.5 mg/day. Balanced diets usually contain pyridoxine, therefore deficiency is rare.
- VITAMIN B12
- Vitamin B12 is a complex organo-metallic compound with a cobalt atom. The preparation which is therapeutically used is cyanocobalamine.
- Vitamin B 12 cooperates with foliate in the synthesis of DNA.
- Vitamin B 12 has a separate biochemical role, unrelated to folate, in synthesis of fatty acids in myelin
- Vitamin B12 deficiency
- Vitamin B12 deficiency is associated with megaloblastic anaemia (per nicous anaemia), demyelinating neurological lesions in the spinal cord and infertility (in animal species). Dietary deficiency of B12 may arise the subjects who are strict vegetarians and eat no animal product. At the present time there is little evidence that vitamin B12 deficiency anaemia represents an important public health problem.

FOLIC ACID

- It is essential for DNA Synthesis.
- Needed for making red blood cells. Sources: Green leaves, vegetables, liver, egg, pulses, cereals, nuts, whole grains and oil seeds.

Daily Requirements

- Adults: 100 micro grams per day.
- Pregnant women: 300 micrograms
- For lactating women additional 150 micrograms.
- Children need 100 micrograms.

VITAMIN C

- Vitamin C (ascorbic acid) is a watersoluble vitamin. It is the most sensitive of all vitamins to heat. Man, monkey and guinea pig are perhaps the only species known to require vitamin C in their diet
- Vitamin C has an important role to play in tissue oxidation it is needed for the formation of collagen, which accounts for 25 per cent of total body protein

- Deficiency of vitamin C
- Deficiency of vitamin C results in scurvy, the signs of which are swollen and bleeding gums, subcutaneous bruising or bleeding into the skin or joints, delayed wound healing, anaemia and weakness. Scurvy which was once an important deficiency disease is no longer a disease of world importance.

Questions:

1. What are water soluble vitamins?
2. Explain the functions of each water soluble vitamins in brief.

References:

1. Hermann W, et al: Enhanced bone metabolism in vegetarians—the role of vitamin B12 deficiency, ClinChem Lab Med 47:1381, 2009.
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3. Chen TC: Vitamin D deficiency: a worldwide problem with health consequences, Am J ClinNutr 87:1080S, 2008. Holick MF: Vitamin D deficiency, Med Prog 357:266, 2007.
4. Holick MF: Resurrection of vitamin D deficiency and rickets, J Clin Invest 116:2062, 2006.
5. Institute of Medicine, Food and Nutrition Board: Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline, Washington, DC, 2000a, National Academies Press.

CHAPTER 8
MINERALS

Macrominerals

Major minerals

Mineral	Function	Sources
Sodium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, breads, vegetables, and unprocessed meats
Chloride	Needed for proper fluid balance, stomach acid	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, meats, breads, and vegetables
Potassium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Meats, milk, fresh fruits and vegetables, whole grains, legumes
Calcium	Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation, immune system health	Milk and milk products; canned fish with bones (salmon, sardines); fortified tofu and fortified soy milk; greens (broccoli, mustard greens); legumes
Phosphorus	Important for healthy bones and teeth; found in every cell; part of the system that maintains acid-base balance	Meat, fish, poultry, eggs, milk, processed foods (including soda pop)
Magnesium	Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health	Nuts and seeds; legumes; leafy, green vegetables; seafood; chocolate; artichokes; "hard" drinking water
Sulfur	Found in protein molecules	Occurs in foods as part of protein: meats, poultry, fish, eggs, milk, legumes, nuts

Trace minerals (microminerals)

The body needs trace minerals in very small amounts. Note that **iron** is considered to be a trace mineral, although the amount needed is somewhat more than for other microminerals.

Trace minerals

Mineral	Function	Sources
Iron	Part of a molecule (hemoglobin) found in red blood cells that carries oxygen in the body; needed for energy metabolism	Organ meats; red meats; fish; poultry; shellfish (especially clams); egg yolks; legumes; dried fruits; dark, leafy greens; iron-enriched breads and cereals; and fortified cereals
Zinc	Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health	Meats, fish, poultry, leavened whole grains, vegetables
Iodine	Found in thyroid hormone, which helps regulate growth, development, and metabolism	Seafood, foods grown in iodine-rich soil, iodized salt, bread, dairy products
Selenium	Antioxidant	Meats, seafood, grains
Copper	Part of many enzymes; needed for iron metabolism	Legumes, nuts and seeds, whole grains, organ meats, drinking water
Manganese	Part of many enzymes	Widespread in foods, especially plant foods
Fluoride	Involved in formation of bones and teeth; helps prevent tooth decay	Drinking water (either fluoridated or naturally containing fluoride), fish, and most teas
Chromium	Works closely with insulin to regulate blood sugar (glucose) levels	Unrefined foods, especially liver, brewer's yeast, whole grains, nuts, cheeses
Molybdenum	Part of some enzymes	Legumes; breads and grains; leafy greens; leafy, green vegetables; milk; liver

Other trace nutrients known to be essential in tiny amounts include nickel, silicon, vanadium, and cobalt.

Food sources of mineral

Major:

Calcium: yogurt, cheese, milk, salmon, leafy green vegetables

Chloride: salt

Magnesium: Spinach, broccoli, legumes, seeds, whole-wheat bread

Potassium: meat, milk, fruits, vegetables, grains, legumes

Sodium: salt, soy sauce, vegetables

Trace:

Chromium: meat, poultry, fish, nuts, cheese

Copper: shellfish, nuts, seeds, whole-grain products, beans, prunes

Fluoride: fish, teas

Iodine: Iodized salt, seafood

Iron: red meat, poultry, eggs, fruits, green vegetables, fortified bread

Manganese: nuts, legumes, whole grains, tea

Selenium: Organ meat, seafood, walnuts

Zinc: meat, shellfish, legumes, whole grains

Functions of water

Water Protects Your Tissues, Spinal Cord, and Joints

Water does more than just quench your thirst and regulate your body's temperature; it also keeps the tissues in your body moist. You know how it feels when your eyes, nose, or mouth gets dry? Keeping your body hydrated helps it retain optimum levels of moisture in these sensitive areas, as well as in the blood, bones, and the brain. In addition, water helps protect the spinal cord, and it acts as a lubricant and cushion for your joints.

Water Helps Your Body Remove Waste

Adequate water intake enables your body to excrete waste through perspiration, urination, and defecation. The kidneys and liver use it to help flush out waste, as do your intestines. Water can also keep you from getting constipated by softening your stools and helping move the food you've eaten through your intestinal tract. However, it should be noted that there is no evidence to prove that increasing your fluid intake will cure constipation.

Water Aids in Digestion

Digestion starts with saliva, the basis of which is water. Digestion relies on enzymes that are found in saliva to help break down food and liquid and to dissolve minerals and other nutrients. Proper digestion makes minerals and nutrients more accessible to the body. Water is also necessary to help you digest soluble fiber. With the help of water, this fiber dissolves easily and benefits your bowel health by making well-formed, soft stools that are easy to pass.

Water Prevents You From Becoming Dehydrated

Your body loses fluids when you engage in vigorous exercise, sweat in high heat, or come down with a fever or contract an illness that causes vomiting or diarrhea. If you're losing fluids for any of these reasons, it's important to increase your fluid intake so that you can restore your body's natural hydration levels. Your doctor may also recommend that you drink more fluids to help treat other health conditions, like bladder infections and urinary tract stones. If you're pregnant or nursing, you may want to consult with your physician about your fluid intake because your body will be using more fluids than usual, especially if you're breastfeeding.

How Much Water Do You Need?

There's no hard and fast rule, and many individuals meet their daily hydration needs by simply drinking water when they're thirsty, according to a report on nutrient recommendations from the Institute of Medicine of the National Academies. In fact, most people who are in good physical health get enough fluids by drinking water and other beverages when they're thirsty, and also by drinking a beverage with each of their meals, according to the Centers for Disease Control and Prevention. If you're not sure about your hydration level, look at your urine. If it's clear, you're in good shape. If it's dark, you're probably dehydrated.

Questions:

1. What are the role of water in our body, explain
2. What are minerals and its role in our body? Explain any 4 minerals

References:

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CHAPTER 9

HUMAN NUTRITIONAL REQUIREMENTS (RDA) THROUGH LIFE CYCLES

We need essential amino acids, carbohydrate, essential fatty acids, and 28 vitamins and minerals to sustain life and health. However, nutritional needs vary from one life stage to another. During intrauterine development, infancy, and childhood, for example, recommended intakes of macronutrients and most micronutrients are higher relative to body size, compared with those during adulthood. In elderly persons, some nutrient needs (e.g., vitamin D) increase, while others (e.g., energy and iron) are reduced.

FERTILITY

The role of nutrition in fertility has been the subject of a limited body of research focusing particularly on the role of antioxidants, other micronutrients, and alcohol. However, while nutritional and lifestyle factors may affect fertility directly, they also influence risk for several diseases that impair fertility, including polycystic ovarian syndrome, endometriosis, and uterine fibroids

In females, some studies suggest a potential role for high-dose (750 mg/d) vitamin C and combinations of antioxidants, iron, and arginine supplements in achieving pregnancy. Celiac disease, an immune-mediated condition triggered by gluten, can also impair fertility in women by causing amenorrhea, inducing malabsorption of nutrients needed for organogenesis, and resulting in spontaneous abortion. In affected individuals, fertility may be improved by a gluten-free diet. Obesity is also associated with decreased fertility in women.

In males, infertility may occur by disruption of the normal equilibrium between the production of reactive oxygen species by semen and oxygen-radical scavengers. This may occur through smoking, infection of the reproductive tract, varicocele, and perhaps through poor diet as well. Alcohol consumption is associated with decreased fertility in both women and men. In males, alcohol consumption contributes to impotence and to a reduction of blood testosterone concentrations and impairment of Sertoli cell function and sperm maturation.

PREGNACY AND LACTATION

Pregnant and lactating women have increased requirements for both macronutrients and micronutrients. The failure to achieve required intakes may increase risk for certain chronic diseases in their children, sometimes manifesting many years later.

Protein requirements in pregnancy rise to 1.1 g/kg/d (71 g) to allow for fetal growth and milk production. The source of protein may be as important as the quantity, however. Some

evidence suggests that protein requirements can be more safely met by vegetable than by animal protein.

Pregnant and/or lactating women also require increased amounts of vitamins A, C, E, and certain B vitamins (thiamine, riboflavin, niacin, pyridoxine, choline, cobalamin, and folate). Folate intake is especially important for the prevention of neural tube defects and should be consumed in adequate amounts prior to conception; evidence shows that average intakes are onl y~ 60% of current recommendations. Folate intakes were noted to be poorest in women eating a typical Western diet and highest in women eating vegetarian diets.Pregnant women also require increased amounts of calcium, phosphorus, magnesium, iron, zinc, potassium, selenium, copper, chromium, manganese, and molybdenum.[1] Prenatal vitamin-mineral formulas are suggested to increase the likelihood that these nutrient needs will be met.

INFANCY AND EARLY CHILDHOOD

Requirements for macronutrients and micronutrients are higher on a per-kilogram basis during infancy and childhood than at any other developmental stage. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy, and nutrients involved in DNA synthesis and metabolism of protein, calories, and fat

Energy. While most adults require 25 to 30 calories per kg, a 4 kg infant requires more than 100 cals/kg (430 calories/day). Infants 4 to 6 months who weigh 6 kg require roughly 82 cals/kg (490 calories/day). Energy needs remain high through the early formative years. Children 1 to 3 years of age require approximately 83 cals/kg (990 cals/d). Energy requirements decline thereafter and are based on weight, height, and physical activity.

Protein. Older infants, aged 7-12 months have an Recommended Daily Allowance (RDA) for protein of 1.2 g/kg/d, or 11 g/d of protein. Children aged 1–3 years have an RDA o 1.05 g/kg/d or 13 g/d of protein and children aged 4–8 years have an RDA of 0.95 g/kg/d or 19 g/d of protein

Water. Total water requirements (from beverages and foods) are also higher in infants and children than for adults. Children have larger body surface area per unit of body weight and a reduced capacity for sweating when compared with adults, and therefore are at greater risk of morbidity and mortality from dehydration.

Essential fatty acids. Requirements for fatty acids on a per-kilogram basis are higher in infants than adults (see below). Through desaturation and elongation, linolenic and alpha-linolenic acids are converted to long-chain fatty acids (arachidonic and docosahexanoic acids) that play key roles in the central nervous system. Since both saturated fats and trans fatty acids inhibit these pathways, infants and children should not ingest foods that contain a predominance of these fats.

ADOLSCENCE AND ADULTHOOD

The Institute of Medicine recommends higher intakes of protein and energy in the adolescent population for growth. For most micronutrients, recommendations are the same as for adults. Exceptions are made for certain minerals needed for bone growth (e.g., calcium and phosphorus). However, these recommendations are controversial, given the lack of evidence that higher intakes are an absolute requirement for bone growth. Evidence is clearer that bone calcium accretion increases as a result of exercise rather than from increases in calcium intake.

Micronutrient needs in adults 19 to 50 years of age differ slightly according to gender. Males require more of vitamins C, K, B 1, B 2, and B 3; choline; magnesium; zinc; chromium; and manganese. Menstruating females require more iron, compared with males of similar age.

LATER YEARS

Due to reductions in lean body mass, metabolic rate, and physical activity, elderly persons require less energy than younger individuals need.

Some elderly persons have difficulty getting adequate nutrition because of age- or disease-related impairments in chewing, swallowing, digesting, and absorbing nutrients. Nutrient status may also be affected by decreased production of digestive enzymes, senescent changes in the cells of the bowel surface, and drug-nutrient interactions

Nutritional interventions should first emphasize healthful foods, with supplements playing a judicious secondary role. Although modest supplementary doses of micronutrients can both prevent deficiency and support immune function (see Upper Respiratory Infection chapter), overzealous supplementation (e.g., high-dose zinc) may have the opposite effect and result in immunosuppression. Multiple vitamin-mineral supplements have not been consistently shown to reduce the incidence of infection in elderly individuals. The effects of multiple vitamin-mineral supplementation on cancer risk may be mixed, with some studies showing benefitand others showing increased cancer risk related to supplement use (e.g., increased risk for prostate cancer and non-Hodgkin lymphoma in women). Risks may be specific to certain nutrients. For example, high calcium intake has been associated with prostate cancer risk (see Prostate Cancer chapter), while other micronutrients have protective effects.

Changing Nutrient Needs through the Life Cycle

Pregnancy*	**Increased requirements:** energy, protein, essential fatty acids, vitamin A, vitamin C, B-vitamins (B_1, B_2, B_3, B_5, B_6, B_{12}, folate, choline) & calcium, phosphorus,** magnesium, potassium, iron, zinc, copper, chromium, selenium, iodine, manganese, molybdenum
Lactation*	**Increased requirements:** vitamins A, C, E, all B-vitamins, sodium, magnesium** **Decreased requirements:** iron

Infancy, childhood*	**Increased requirements:** energy, protein, essential fatty acids
Adolescence*	**Increased requirements:** energy, protein, calcium, phosphorus, magnesium, zinc (females only)
Early adulthood (ages 19-50)	**Increased requirements for males, compared with females:** vitamins C, K; B_1, B_2, B_3, and choline; magnesium, zinc, chromium, manganese **Increased requirements for females, compared with males:** iron
Middle age (ages 51-70)*	**Increased requirements:** vitamin B_6, vitamin D
Elderly (age 70+)*	**Increased requirements:** vitamin D **Decreased requirements:** energy; iron (females only)

Questions:

1. What are nutritional requirements changes during childhood to adolescence
2. Describe the nutritional requirements of pregnancy and lactation.

References:

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2. World Health Organization: Prevention and management of osteoporosis. Report of a Scientific Group, WHO Technical Report Series no. 921, Geneva, 2003, World Health Organization

CHAPTER 10

PRINCIPLES OF MEAL PLANNING

Principle of nutrition
Principle of nutrition is an important principle of meal planning. A family may have members of all age groups like infant, adolescent, adult, pregnant lady, old person, etc. Nutritional requirement of each member may differ. Hence it is necessary to consider the daily nutritional requirement of each member.

Meal pattern must suit the family
No two families have exactly the same nutritional needs since the differences in the number of family members, their age and their food likes and dislikes. Apart from this, number of meals taken in a day by the family also differs. For example, if a family takes two main meals in a day, then the maximum nutritional requirements should be met by these two meals in case if meals are taken thrice a day, the quantity of food in each meal can be lessened.

The food should be in accordance with the requirements of different members of the family. This doesn't mean that separate food should be cooked for each member. Requirements of each family member can be met by making a few changes in the meal, e.g., dal water can be served as soup, and dal can be served to a patient of hypertension by reducing the amount of salt in it. Non-fried dal can be served to a patient and rest of the members can enjoy fried dal.

To bring variety in meals
Nobody likes a rigid meal pattern every day. One can be fed up howsoever nutritious

is a must so that all the members enjoy it can be done by selecting different foods various food groups, by blending color flavour, taste, and texture into it, and by u different methods of cooking.

(i) Selection of foods from differ Food Groups
A group of foodstuffs ha ‘ same nutrients are called a Food Group. F selected from a single food group are neat acceptable nor balanced, e.g., a person ha ‘ milk, cheese, sandwich, and milk pudding breakfast may not relish his breakfast, but the other hand if foods from different groups are selected, e.g., vegetable sandwich fruits and milk are served, it will definite bring variety and also enhance the taste nutritive value of the meal.

(ii) Variety in colour combination
Blending of different colours make food attractive and likeable on the contrary food appears dull if all foods are of the same colour, e.g., a meal consisting of uric duly dal, plain curd, plain rice, onion and radish salad does not appeal despite of being nutritious. But if a meal

has whole rued dal, dam aloof, onion, tomato, radish and carrot salad decorated with green coriander, ratio, mint chutney and rice pula, it appeals you because of beautiful colours. Such a meal enhances appetite.

(iii) Variety in texture

Texture in food refers to its state of being soft, solid, crisp or liquid. A meal won't be enjoyable if all the foods are of the same texture. So a meal should have some solid foods which can be consumed raw like salads, fruits, etc., some crispy foods like chips, papa, etc., and some soft like custard, pudding, dal, etc.

(iv) Variety in taste and flavour

A meal is really very sumptuous if its flavour can water your mouth. All the tastes like salty, sour, sweet and bitter add novelty to food. You won't be able to relish the meal if all the foods in it are very spicy. A bland meal is also not very likeable.

Blending of different flavors is also essential for a good meal planning. Good combination of foods generally enhances the flavour of each other, e.g., bread with butter, pakoras with mint chutney, with coconut chutney, etc.

(v) Variety in methods of cooking

Texture, taste and flavour of foods can be changed by using different methods of cooking. In addition to the traditional cooking methods like frying, boiling, roasting, baking, steaming etc., novelty to the food can also be added by fermentation and sprouting. For example, potato can be served in different forms like potato ratio, kaftans, cutlets, hallway, chips, etc. in place of simple potato vegetable.

4. Meals should provide satiable value

Food which provides satiety and does not cause hunger between two meals is known as satiable food. Protein and fat rich foods have higher satiety value as compared to carbohydrates. That's why one doesn't feel after having such foods.

In meal planning, interval between two meals should considered while selecting protein and fat foods so that one doesn't feel hungry v soon, e.g., the interval between dinner breakfast is long, therefore, protein and rich breakfast will be more satiable.

5. To save time, energy and money

Time, energy and money can be saving by meal planning:

• Once meals are planned for a day o week then first prepare a list of items and they should be procured time. This saves unnecessary trips; the market and thus saves time, en and money.

• Foods can be purchased at reason prices. For this, rates can be comp- at different shops or can be proc: from wholesale dealers. Items purchased at the last moment in a hurry cost more.

• Foods in a bigger pack cost less but should be purchased only when the proper provision for its storage.

• Shopping should be done at times the markets are not very crowded.

• Kitchen items should be arranged thematically near the work place so as avoid fatigue while working in the kite

• Time and labour saving kitchen Devi like mixer, fridge, cooker, solar cook etc., should be used.

• Meal planning helps in pre-preparat[1] of food, e.g., if rajma is to be cooked lunch, these can be soaked overnice Soaked grains are easy to cook and sale time and fuel.

Questions:

1. What is meal planning?
2. What are the principles of meal planning

References:

1. U.S. Department of Health and Human Services (USDHHS): Small steps: a web-based wellness program, April 2006.

2. World Health Organization (WHO): Progress on health-related millennium development goals (MDGs), Copenhagen, May 2009, WHO.

CHAPTER 11

WAY TO INCREASE NUTRITIONAL QUALITY OF FOOD

Path to improved health

It can be hard to change your eating habits. It helps if you focus on small changes. Making changes to your diet may also be beneficial if you have diseases that can be made worse by things you are eating or drinking. Symptoms from conditions such as kidney disease, lactose intolerance, and celiac disease can all benefit from changes in diet. Below are suggestions to improve your health. Be sure to stay in touch with your doctor so they know how you are doing.

- Find the strong and weak points in your current diet. Do you eat 4-5 cups of fruits and vegetables every day? Do you get enough calcium? Do you eat whole grain, high-fiber foods? If so, you're on the right track! Keep it up. If not, add more of these foods to your daily diet.
- Keep track of your food intake by writing down what you eat and drink every day. This record will help you assess your diet. You'll see if you need to eat more or less from certain food groups.
- Think about asking for help from a dietitian. They can help you follow a special diet, especially if you have a health issue.

Almost everyone can benefit from cutting back on unhealthy fat. If you currently eat a lot of fat, commit to cutting back and changing your habits. Unhealthy fats include things such as: dark chicken meat; poultry skin; fatty cuts of pork, beef, and lamb; and high-fat dairy foods (whole milk, butter, cheeses). Ways to cut back on unhealthy fats include:

- Rather than frying meat, bake, grill, or broil it. Take off the skin before cooking chicken or turkey. Try eating fish at least once a week.
- Reduce any extra fat. This includes butter on bread, sour cream on baked potatoes, and salad dressings. Use low-fat or nonfat versions of these foods.
- Eat plenty of fruits and vegetables with your meals and as snacks.
- Read the nutrition labels on foods before you buy them. If you need help with the labels, ask your doctor or dietitian.
- When you eat out, be aware of hidden fats and larger portion sizes.
- Staying hydrated is important for good health. Drink zero- or low-calorie beverages, such as water or tea. Sweetened drinks add lots of sugar and calories to your diet. This includes fruit juice, soda, sports and energy drinks, sweetened or flavored milk, and sweetened iced tea.

Things to consider

Balanced nutrition and regular exercise are good for your health. These habits can help you lose or maintain weight. Try to set realistic goals. They could be making some of the small diet changes listed above or walking daily.

Doctors and dietitians suggest making healthy eating habits a part of daily life rather than following fad diets. Nutrition tips and diets from different sources can be misleading. Keep in mind the advice below, and always check with your doctor first.

- Secret diets aren't the answer. Fad or short-term diets may promise to help you lose weight fast. However, they are hard to keep up with and could be unhealthy.
- Good nutrition doesn't come in a pill. Try eating a variety of foods instead. Your body benefits most from healthy whole foods. Only take vitamins that your doctor prescribes.
- Diet programs or products can confuse you with their claims. Most people in these ads get paid for their endorsements. They don't talk about side effects, problems, or regained weight.
- **Enrichment, fortification**
- Food fortification is the process of adding micronutrients (essential trace elements and vitamins) to food. It may be a purely commercial choice to provide extra nutrients in a food, while other times it is a public health policy which aims to reduce the number of people with dietary deficiencies within a population. Diets that lack variety can be deficient in certain nutrients. Sometimes the staple foods of a region can lack particular nutrients, due to the soil of the region or because of the inherent inadequacy of the normal diet. The four main methods of food fortification (named as to indicate the procedure that is used in order to fortify the food):

- 1) Bio-fortification (i.e. breeding crops to increase their nutritional value, which can include both conventional selective breeding, and modern genetic modification)

- 2) Synthetic biology (i.e. addition of pro-biotic bacteria to foods)

- 3) Commercial and industrial fortification (i.e. flour, rice, oils (common cooking foods))

- 4) Home fortification (e.g. vitamin D drops) Some examples of food fortification are Iodized Salts, Folic Acid, Niacin, Vitamin D, Fluoride, Golden Rice, White Rice, etc. An enriched food is a food to which nutrients have been added. Typically, the added nutrients were present in the food in its original form, but were removed at some point during processing. White bread -- to which certain vitamins are added after the bleaching process depletes them -- is a commonly consumed enriched food. While it is true that both fortification and enrichment refer to the addition of nutrients to food, the true definitions do slightly vary. As defined by the World Health Organization (WHO) and the Food and Agricultural Organization of the United Nations (FAO), fortification refers to "the practice of deliberately

increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food irrespective of whether the nutrients were originally in the food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health," whereas enrichment is defined as "synonymous with fortification and refers to the addition of micronutrients to a food which are lost during processing. Restoration is the addition of a nutrient to a food in order to restore the original nutrient content. Both restoration and enrichment programmes usually involve the addition of nutrients that are naturally available or present in the food product. Standardization is the addition of nutrients to foods to compensate for natural variation, so that a standard level is achieved. Standardization is an important step to ensure a consistent standardized quality of the final product. Supplementation is the addition of nutrients that are not normally present or are present in only minute quantities in the food. More than one nutrient may be added, and they may be added in high quantities. As compared with restoration and standardization, fortification has a special meaning: the nutrient added and the food chosen as a carrier have met certain criteria, so that the fortified product will become a good source of the nutrient for a targeted population. Nutrients added for food fortification may or may not have been present in the food carrier originally.

- **Fermentation and mutual supplementation**

- **Fermentation** is the process of converting carbohydrates to alcohol or organic acids using microorganisms—yeasts or bacteria—under anaerobic conditions. Fermentation usually implies that the action of microorganisms is desired. The science of fermentation is known as zymology or zymurgy.
- The term fermentation sometimes refers specifically to the chemical conversion of sugars into ethanol, producing alcoholic drinks such as wine, beer, and cider. However, similar processes take place in the leavening of bread (CO_2 produced by yeast activity), and in the preservation of sour foods with the production of lactic acid, such as in sauerkraut and yogurt.
- Other widely consumed fermented foods include vinegar, olives, and cheese. More localised foods prepared by fermentation may also be based on beans, grain, vegetables, fruit, honey, dairy products, and fish.
- Food fermentation is the conversion of sugars and other carbohydrates into alcohol or preservative organic acids and carbon dioxide. All three products have found human uses. The production of alcohol is made use of when fruit juices are converted to wine, when grains are made into beer, and when foods rich in starch, such as potatoes, are fermented and then distilled to make spirits such as gin and vodka. The production of carbon dioxide is used to leaven bread. The production of organic acids is exploited to preserve and flavor vegetables and dairy products.

- Food fermentation serves five main purposes: to enrich the diet through development of a diversity of flavors, aromas, and textures in food substrates; to preserve substantial amounts of food through lactic acid, alcohol, acetic acid, and alkaline fermentations; to enrich food substrates with protein, essential amino acids, and vitamins; to eliminate anti-nutrients; and to reduce cooking time and the associated use of fuel.

Questions:

1. How to increase nutritional quality of food?
2. Describe any two methods to increases the nutritional quality of food?

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CHAPTER 12

COMMON NUTRITIONAL DEFICIENCIES

7 nutrient deficiencies that is incredibly common.

1. Iron deficiency

Iron is an essential mineral.

It's a large component of red blood cells, in which it binds with hemoglobin and transports oxygen to your cells.

The two types of dietary iron are:

- **Heme iron.** This type of iron is very well absorbed. It's only found in animal foods, with red meat containing particularly high amounts.
- **Non-heme iron.** This type, found in both animal and plant foods, is more common. It is not absorbed as easily as heme iron.

Iron deficiency is one of the most common nutrient deficiencies in the world, affecting more than 25% of people worldwide.

This number rises to 47% in preschool children. Unless they're given iron-rich or iron-fortified foods, they are very likely to lack iron.

Around 30% of menstruating women may be deficient as well due to monthly blood loss, and up to 42% of young, pregnant women may be deficient as well.

Additionally, vegetarians and vegans have an increased risk of deficiency because they consume only non-heme iron, which is not absorbed as well as heme iron

The most common consequence of iron deficiency is anemia, in which the number of your red blood cells and your blood's ability to carry oxygen drops.

Symptoms usually include tiredness, weakness, a weakened immune system, and impaired brain function.

The best dietary sources of heme iron include:

- **Red meat.** 3 ounces (85 grams) of ground beef provide almost 30% of the Daily Value (DV).
- **Organ meat.** One slice (81 grams) of liver gives more than 50% of the DV.
- **Shellfish.** Clams, mussels, and oysters are excellent sources of heme iron, with 3 ounces (85 grams) of cooked oysters packing roughly 50% of the DV.
- **Canned sardines.** One 3.75-ounce (106-gram) can offer 34% of the DV.

The best dietary sources of non-heme iron include:

- **Beans.** Half a cup (85 grams) of cooked kidney beans provides 33% of the DV.
- **Seeds.** Pumpkin, sesame, and squash seeds are good sources of non-heme iron. One ounce (28 grams) of roasted pumpkin or squash seeds contains 11% of the DV.
- **Dark, leafy greens.** Broccoli, kale, and spinach are rich in iron. One ounce (28 grams) of fresh kale provides 5.5% of the DV.

However, you should never supplement with iron unless you truly need it. Too much iron can be very harmful.

Notably, vitamin C can enhance the absorption of iron. Eating vitamin-C-rich foods like oranges, kale, and bell peppers alongside iron-rich foods can help maximize your iron absorption.

2. Iodine deficiency

Iodine is an essential mineral for normal thyroid function and the production of thyroid hormone.

Thyroid hormones are involved in many bodily processes, such as growth, brain development, and bone maintenance. They also regulate your metabolic rate.

Iodine deficiency is one of the most common nutrient deficiencies, affecting nearly a third of the world's population.

The most common symptom of iodine deficiency is an enlarged thyroid gland, also known as a goiter. It may also cause an increase in heart rate, shortness of breath, and weight gain.

Severe iodine deficiency is linked to serious harm, especially in children. It may cause mental retardation and developmental abnormalities.

Good dietary sources of iodine include:

- **Seaweed.** Only 1 gram of kelp packs 460–1,000% of the DV.
- **Fish.** Three ounces (85 grams) of baked cod provide 66% of the DV.
- **Dairy.** One cup (245 grams) of plain yogurt offers about 50% of the DV.
- **Eggs:** One large egg contains 16% of the DV.

However, these amounts can vary greatly. As iodine is found mostly in soil and ocean water, iodine-poor soil will result in low-iodine food.

Some countries mandate the enrichment of table salt with iodine, which has successfully reduced the incidence of deficiencies.

3. Vitamin D deficiency

Vitamin D is a fat-soluble vitamin that functions like a steroid hormone in your body.

It travels through your bloodstream and into cells, telling them to turn genes on or off. Almost every cell in your body has a receptor for vitamin D.

Vitamin D is produced from cholesterol in your skin upon exposure to sunlight. Thus, people who live far from the equator are likely to be deficient unless their dietary intake is adequate or they supplement with vitamin D.

In the United States, about 42% of people may be deficient in this vitamin. This number rises to 74% in older adults and 82% in people with dark skin since their skin produces less vitamin D in response to sunlight.

Vitamin D deficiency is not usually obvious, as its symptoms are subtle and may develop over years or decades.

Adults who are deficient in vitamin D may experience muscle weakness, bone loss, and an increased risk of fractures. In children, it may cause growth delays and soft bones (rickets).

Also, vitamin D deficiency may play a role in reduced immune function and an increased risk of cancer.

While very few foods contain significant amounts of this vitamin, the best dietary sources are:

- **Cod liver oil.** A single tablespoon (15 ml) packs 227% of the DV.
- **Fatty fish.** Salmon, mackerel, sardines, and trout are rich in vitamin D. A small, 3-ounce (85-gram) serving of cooked salmon provides 75% of the DV.
- **Egg yolks.** One large egg yolk contains 7% of the DV.

People who are deficient may want to take a supplement or increase their sun exposure. It is hard to get sufficient amounts through diet alone.

4. Vitamin B12 deficiency

Vitamin B12, also known as cobalamin, is a water-soluble vitamin.

It is essential for blood formation, as well as brain and nerve function.

Every cell in your body needs B12 to function normally, but your body is unable to produce it. Therefore, you must get it from food or supplements.

B12 is only found in sufficient amounts in animal foods, although certain types of seaweed may provide small quantities. Therefore, people who do not eat animal products are at an increased risk of deficiency.

Studies indicate that up to 80–90% of vegetarians and vegans may be deficient in vitamin B12.

More than 20% of older adults may also be deficient in this vitamin since absorption decreases with age.

B12 absorption is more complex than that of other vitamins because it's aided by a protein known as intrinsic factor. Some people are lacking in this protein and may thus need B12 injections or higher doses of supplements.

One common symptom of vitamin B12 deficiency is megaloblastic anemia, which is a blood disorder that enlarges your red blood cells.

Other symptoms include impaired brain function and elevated homocysteine levels, which is a risk factor for several diseases.

Dietary sources of vitamin B12 include:

- **Shellfish.** Clams and oysters are rich in vitamin B12. A 3-ounce (85-gram) portion of cooked clams provides 1,400% of the DV.
- **Organ meat.** One 2-ounce (60-gram) slice of liver packs more than 1,000% of the DV.
- **Meat.** A small, 6-ounce (170-gram) beef steak offers 150% the DV.
- **Eggs.** One whole egg provides about 6% of the DV.
- **Milk products.** One cup (240 ml) of whole milk contains about 18% of the DV.

Vitamin B12 isn't considered harmful in large amounts because it's often poorly absorbed and easily excreted.

5. **PEM, iron, vitamin A**

DEFINATION

Protein-energy **malnutrition** (PEM) is a potentially fatal body-depletion disorder. It is the leading cause of death in children in developing countries.

DESCRIPTION

PEM is also referred to as protein-calorie malnutrition. It develops in children whose consumption of protein and energy (measured by calories) is insufficient to satisfy their nutritional needs. While pure protein deficiency can occur when a person's diet provides enough energy but lacks an adequate amount of protein, in most cases deficiency will exist in both total calorie and protein intake. PEM may also occur in children with illnesses that leave them unable to absorb vital nutrients or convert them to the energy essential for healthy tissue formation and organ function.

Types of PEM

Primary PEM results from a diet that lacks sufficient sources of protein. Secondary PEM is more common in the United States, where it usually occurs as a complication of **AIDS** , **cancer**, chronic kidney failure, inflammatory bowel disease, and other illnesses that impair the body's ability to absorb or use nutrients or to compensate for nutrient losses. PEM can develop gradually in a child who has a chronic illness or experiences chronic semi-starvation. It may appear suddenly in a patient who has an acute illness.

Kwashiorkor, also called wet protein-energy malnutrition, is a form of PEM characterized primarily by protein deficiency. This condition usually appears at about the age of 12 months

when breast-feeding is discontinued, but it can develop at any time during a child's formative years. It causes fluid retention (edema); dry, peeling skin; and hair discoloration.

Marasmus, a PEM disorder, is caused by total calorie/energy depletion rather than primarily protein calorie/energy depletion. Marasmus is characterized by stunted growth and wasting of muscle and tissue. Marasmus usually develops between the ages of six months and one year in children who have been weaned from breast milk or who suffer from weakening conditions such as chronic **diarrhea**.

CAUSES AND SYMPTOMS

Secondary PEM symptoms range from mild to severe, and can alter the form or function of almost every organ in the body. The type and intensity of symptoms depend on the patient's prior nutritional status, the nature of the underlying disease, and the speed at which the PEM is progressing.

Mild, moderate, and severe classifications for PEM have not been precisely defined, but patients who lose 10–20 percent of their body weight without trying may have moderate PEM. Some of the cause is replacement dependent (i.e. patients do not take in adequate protein during recovery from illness). This level of PEM is characterized by a weakened grip and inability to perform high-energy tasks.

Losing 20 percent of body weight or more is generally classified as severe PEM. Children with this condition cannot eat normal-sized meals. They have slow heart rates and low blood pressure and body temperatures. Other symptoms of severe secondary PEM include baggy, wrinkled skin; **constipation**; dry, thin, or brittle hair; lethargy; pressure sores, and other skin lesions.

Children suffering from kwashiorkor often have extremely thin arms and legs, but liver enlargement and ascites (abnormal accumulation of fluid) can distend the abdomen and disguise weight loss. Hair may turn red or yellow. Anemia, diarrhea, and fluid and electrolyte disorders are common. The body's immune system is often weakened, behavioral development is slow, and **mental retardation** may occur. Children may grow to normal height but are abnormally thin.

Kwashiorkor-like secondary PEM usually develops in children who have been severely burned, suffered trauma, or had sepsis (massive tissue-destroying infection) or another life-threatening illness. The condition's onset is so sudden that body fat and muscle mass of normal-weight people may not change. Some patients even gain weight because of fluid retention.

Profound weakness accompanies severe marasmus. Since the body breaks down its own tissue to use for energy, children with this condition lose all their body fat and muscle strength, and acquire a skeletal appearance most noticeable in the hands and in the temporal muscle in front of and above each ear. Children with marasmus are small for their age. Since their immune systems are weakened, they suffer from frequent infections. Other symptoms include loss of appetite, diarrhea, skin that is dry and baggy, sparse hair that is dull brown or

reddish yellow, mental retardation, behavioral retardation, low body temperature (hypothermia), and slow pulse and breathing rates.

The absence of edema (fluid retention) distinguishes marasmus-like secondary PEM, a gradual wasting process that begins with weight loss and progresses to mild, moderate, or severe malnutrition (cachexia). It is usually associated with cancer, chronic obstructive pulmonary disease (COPD), or another chronic disease that progresses very slowly.

Difficulty chewing, swallowing, and digesting food, **pain**, **nausea** , and lack of appetite are among the most common reasons that many hospital patients do not consume enough nutrients. Nutrient loss can be accelerated by bleeding, diarrhea, abnormally high blood sugar levels (glycosuria), kidney disease, malabsorption disorders, and other factors. **Fever** , infection, surgery, and benign or malignant tumors increase the amount of nutrients that hospitalized patients need. Trauma, **burns**, and some medications also increase caloric requirements.

DIAGNONSIS

When the physician suspects PEM, A thorough physical examination is performed, and these areas assessed:

- eating habits and weight changes
- body-fat composition and muscle strength
- gastrointestinal symptoms
- presence of underlying illness
- developmental delays and loss of acquired milestones in children
- nutritional status

Doctors further quantify a patient's nutritional status by:

- comparing height and weight to standardized norms
- calculating body mass index (BMI)
- measuring skinfold thickness or the circumference of the upper arm

Questions:

1. Explain the nutritional deficiency of fat soluble vitamins
2. Explain the nutritional deficiency of water soluble vitamins
3. What is PEM, give its aetiology.

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(Only Speed Post is Received at University Campus Address, No. any Courier Facility is available at Campus Address)

Pages	: 48
Book Price	: ₹ 150/-

Women University Press

Jayoti Publication Desk

Year & Month of Publication-3/3/2021