CHAPTER

Foods, Nutrition and Health

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FOOD HAS been a basic part of our existence. Through the centuries we have acquired a wealth of information about the use of food to ensure growth of children and youth, to maintain good health through life, and to meet special needs of pregnancy and lactation and to use it to recover from illness.

When you study food composition you will know the nutritional contribution of foods. You may have been told that certain foods are very important for maintaining good health, while others are harmful. As you study the science of Foods and Nutrition, you will need to examine the ideas you have about foods very carefully and accept or reject these in the light of the knowledge you will acquire. Whatever you learn in this area should be used and applied in your personal life.

A large part of our food heritage is scientifically beneficial and needs to be retained; some aspects may need to be modified in the view of the changes in our lifestyle.

Food is an important topic of conversations, articles in newspapers and magazines, as also of advertisements. Some of this information may be correct, but a large part of it may not be. As you learn

this subject, you will be able to spread the knowledge gained to those around you, so that they discard false ideas about food, which interfere with their food selection and affect their health.

Food, nutrition and health are intimately connected aspects of our life. Let us start our study by defining these and related terms.

Definitions

Food is that which nourishes the body. Food may also be defined as anything eaten or drunk, which meets the needs for energy, building, regulation and protection of the body. In short, food is the raw material from which our bodies are made. Intake of the right kinds and amounts of food can ensure good nutrition and health, which may be evident in our appearance, efficiency and emotional well-being (Figure 1.1).

Nutrition has been defined as food at work in the body. Nutrition includes everything that happens to food from the time it is eaten until it is used for various functions in the body. Nutrients are components of food that are needed by the body in adequate amounts in order to grow, reproduce and lead a normal, healthy life. Nutrients include water, proteins, fats, carbohydrates, minerals and vitamins. There are several nutrients in each of the groups: proteins, fats, carbohydrates, minerals and vitamins; hence the plural form of these words has been used. Thus there are over 40 essential nutrients supplied by food, which are used to produce literally thousands of substances necessary for life and physical fitness.

The study of the science of nutrition deals with what nutrients we need, how much we need, why we need these and where we can get them. Nutrition is the result of the kinds of foods supplied to the body and how the body uses the food supplied.

Adequate, optimum and good nutrition are expressions used to indicate that the supply of the essential nutrients is correct in amount and proportion. It also implies that the utilisation of such nutrients in the body is such that the highest level of physical and mental health is maintained throughout the life-cycle.

Figure 1.1: A well-nourished child engrossed in play.

Nutritional status is the state of our body as a result of the foods consumed and their use by the body. Nutritional status can be good, fair or poor.

The characteristics of **good nutritional status** are an alert, good natured personality, a well developed body, with normal weight for height, well developed and firm muscles, healthy skin, reddish pink colour of eyelids and membranes of mouth, good layer of subcutaneous fat, clear eyes, smooth and glossy hair, good appetite and excellent general health. General good health is evident by stamina for work, regular meal times, sound regular sleep, normal elimination and resistance to disease.

Poor nutritional status is evidenced by a listless, apathetic or irritable personality, undersized poorly developed body, abnormal body weight (too thin or fat and flabby body), muscles small and flabby, pale or sallow skin, too little or too much subcutaneous fat, dull or reddened eyes, lustreless and rough hair, poor appetite, lack of vigour and endurance for work and susceptibility to infections. Poor nutritional status may be the result of poor food selection, irregularity in schedule of meals, work, sleep and elimination.

The WHO (World Health Organization) has defined **health** as the 'state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'.

Malnutrition means an undesirable kind of nutrition leading to ill-health. It results from a lack, excess or imbalance of nutrients in the diet. It includes **undernutrition** and **overnutrition.** Undernutrition is a state of an insufficient supply of essential nutrients.

Malnutrition can be primarily be due to insufficient supply of one or more essential nutrients; or it can be secondary, which means it results from an error in metabolism, interaction between nutrients or nutrients and drugs used in treatment.

Overnutrition refers to an excessive intake of one or more nutrients, which creates a stress in the bodily function.

Diet refers to whatever you eat and drink each day. Thus it includes the normal diet you consume and the diet people consume in groups (hostel diet). Diet may also be modified and used for ill persons as part of their therapy (therapeutic diets).

Nutritional care is the use of nutritional knowledge in planning meals and the preparation of these meals in an acceptable and attractive manner to feed people. It involves assessment of the exiting meal patterns and improving these in an acceptable manner. While the nutritional plan may be general for a group of people, the actual execution is individualized to suit the person's needs and background. Thus one has to use a lot of ingenuity to succeed in making nutritional care effective in practical terms.

Health the word health refers to the condition of the body, good health not only implies freedom from disease, but physical, mental and emotional fitness as well.

Functions of Food

Physiological functions of food. The first function of the body is to **provide energy.** The body needs energy to sustain the involuntary processes essential for continuance of life, to carry out professional, household and recreational activities, to convert food ingested into usable nutrients in the body, to grow and to keep warm. The energy needed is supplied by the oxidation of the foods consumed.

The foods we eat become a part of us. Thus one of the most important functions of food is **building the body.** A newborn baby weighing 2.7-3.2 kg can grow to its potential adult size of 50–60 kg if the right kinds and amounts of food are eaten from birth to adulthood. The food eaten each day helps to maintain the structure of the adult body, and to **replace** worn out cells of the body.

The third function of food is to **regulate activities of the body**. It includes regulation of such varied activities as:

- Beating of the heart
- Maintenance of the body temperature
- Muscle contraction
- Control of water balance
- Clotting of blood
- Removal of waste products from the body

The fourth function of food is to improve our body's **resistance to disease.**

The Social Functions of Food. Food has always been a central part of our social existence. It has been a part of our community, social, cultural and religious life. Special foods are distributed as a benediction or *prasad* in the religious functions in homes, temples and churches. Feasts are given at specific stages of life such as birth, naming ceremony, birthdays, marriages, etc. Most of the religious festivals also call for feasts and feeding of specific segments of the population. Certain menus are associated with most of these feasts in each region.

Food has been used as an expression of love, friendship and social acceptance. It is also used as a symbol of happiness at certain events in life, for example, *pedhas* are distributed to announce success in examinations, or the birth of a baby; *laddus* are associated with the celebration of Deepavali and marriages, cakes are associated with Christmas and birthdays and *tilgul* with *sankranti* the festival of friendship.

As food is an integral part of our social existence, this function is important in daily life. Refreshments served at get-togethers or meetings create a relaxed atmosphere. The menu for such get-together should bring the people together, rather than divide them. This basic aspect should be considered in planning menus for such occasions (Figure 1.2).

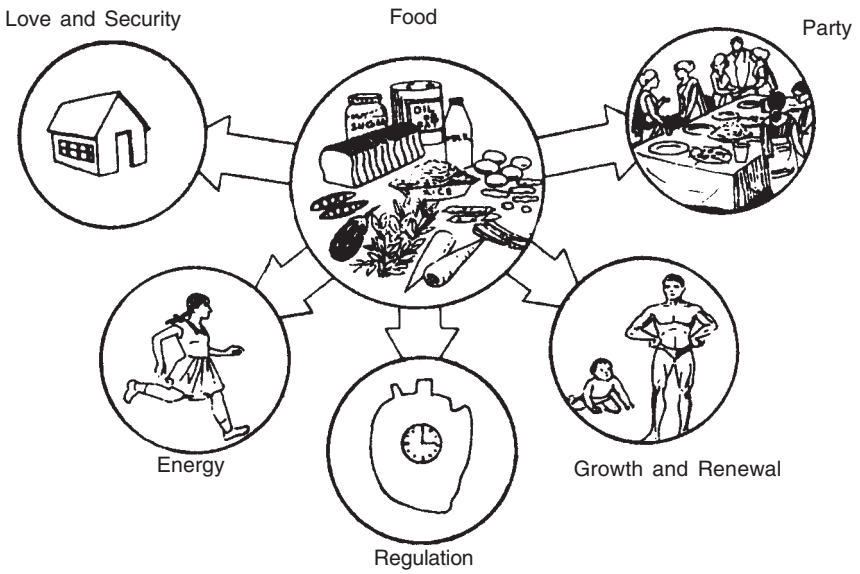

Figure 1.2: Functions of food.

The Psychological Functions of Food. In addition to satisfying physical and social needs, food must satisfy certain emotional needs. These includes a sense of security, love and attention. Thus familiar foods make us feel secure. Anticipating needs and fulfilling these are expressions of love and attention. These sentiments are the basis of the normal attachment to the mother's cooking.

Sharing of food is a token of friendship and acceptance. In a friendly gathering we try unfamiliar foods and thus enlarge our food experiences. It must be noted that even a nutritionally balanced meal may not be satisfying to the individual, if the foods included are unfamiliar or distasteful to him/her. With time and repeated experience, strange foods become familiar and new tastes are formed.

These aspects are important in food acceptance and must be considered in planning meals, which are not only nutritionally adequate, but also enjoyable for the group for whom they are intended.

Functions of Nutrients

The foods which we use daily include rice, wheat, dal, vegetables, fruits, milk, eggs, fish, meat, sugar, butter, oils, etc. These different foods are made up of a number of chemical components called **nutrients.** These are classified according to their chemical composition.

Each nutrient class has its own function, but the various nutrients must act in unison for effective action. The nutrients found in foods are — carbohydrates, proteins, fats, minerals, vitamins and water. Fibre is also an essential component of our diet. The functions of nutrients are given below.

Carbohydrates: Starch found in cereals and sugar in sugarcane and fruits are examples of carbohydrates in foods. The chief function of carbohydrates is to provide energy needed by our body. Those not used immediately for this purpose are stored as glycogen or converted to fat and stored, to be mobilised for energy supply when needed.

Fats: Oils found in seeds, butter from milk, and lard from meat, are examples of fats found in foods. Fats are concentrated sources of energy, carriers of fat soluble vitamins and a source of essential fatty acids. If excess fats are taken in the diet, these are stored as fat reserves in the body. Energy taken in excess of body needs, is stored as fat in the body.

Proteins: Casein from milk, albumin in egg, globulins in legumes and gluten in wheat, are examples of proteins occurring in foods. The main function of protein is the building of new tissues and maintaining and repair of those already built. Synthesis of regulatory and protective substances such as enzymes, hormones and antibodies is also a function of food proteins. About 10 per cent of the total energy is supplied by proteins in the diet. Protein, when taken in excess of the body's need, is converted to carbohydrates and fats and is stored in the body.

Minerals: The minerals calcium, phosphorus, iron, iodine, sodium, potassium and others are found in various foods in combination with organic and inorganic compounds. Minerals are necessary for body-building, for building of bones, teeth and structural parts of soft tissues. They also play a role in regulation of processes in the body, e.g., muscle contraction, clotting of blood, nerve stimuli, etc.

Vitamins: Fat-soluble vitamins A, D, E and K and also water-soluble vitamins C and B group are found in foods. These are needed for growth, normal function of the body and normal body processes.

Water: We get water in foods we eat and a major part from the water we drink as such and as beverages. Water is an essential part of our body structure and it accounts for about 60 per cent of our body weight. Water is essential for the utilisation of food material in the body and also for elimination of food waste. It is a regulator of body processes such as maintenance of body temperature.

All individuals need the same nutrients for the same body function. The only variation is in the amounts of each nutrient required according to age, size, activity, etc. For example, all persons need energy for work, but a man, who carries loads may need more energy than a man, who works in an office at a desk job.

As you know, we get the nutrients from the foods and the beverages we consume. Most foods contain the nutrients in varying amounts. Let us understand the nutrient composition of the foods we use everyday.

Food Composition

Most food contain more than one nutrient. The nutrient contents of foods have been determined by analysing these in the laboratory. The composition of over 650 Indian foods has been determined. Of these, the nutritive value of about 160 foods is presented in the Appendix F.

The food composition tables give the concentration of nutrients in 100 g of the edible portion (E.P.) of the food. Therefore it is important to know **how much of the food purchased is edible.** In some foods, such as milk, butter, sugar, the edible portion is 100 per cent. In fruits and vegetables, it varies from 65 per cent in bananas to 98 per cent in tomatoes.

The values for nutrients given in food composition tables are averages of the results obtained by analysing a large number of samples of each food. Therefore the figures in such tables give a fairly good idea of the composition of each food.

Foods are grouped in the food value tables, on the basis of the plant part from which the food is derived, for example, seeds, roots, leaves, fruits, etc. Animal foods are grouped on the basis of species and the product used.

It is interesting to note that there are inherent similarities in the composition of foods in each group. In Table 1.1, the composition of various foods has been presented to illustrate this point. For example, the protein content of cereals varies from 7 to 12, and that of *dals* and legumes from 17 to 25 per cent. This information has important applications in practical usage of tables. It is possible to predict the overall nutrient content of combinations used, if we know the amounts of individual foods used. If the composition of a particular food is not found in the tables, you can roughly predict its nutrient contribution, by knowing the group to which it belongs.

You may observe from Table 1.1, that cereals and *dals* do not contain vitamins A and C. Therefore you will realise how important it is to include vegetables and fruits, which are rich source of these two vitamins, in our daily menu of cereals and *dal.* Most of the vegetablres and fruits, as you will observe from Table 1.1, are low in calories. Oils, fats and sugars are mainly sources of calories. Thus you get an idea of the contribution of various foods by studying Table 1.1.

Most of the analytical work on Indian foods was carried out in various laboratories under the auspices of Indian Council of Medical Research. A compilation of results is published as the *Nutritive Value of Indian Foods,* by the Indian Council of Medical Research (ICMR). A number of new varieties of food with high contents of certain nutrients, have been developed at research centres under the auspices of the Indian Council of Agricultural Research. You get a number of these foods in the market and use these in your dietary. The nutritive value of these new varieties of foods need to be included in the book on Nutritive Value of Indian Foods. There are two International Food Value tables published by

the Food & Agriculture Organisation (FAO) (please refer to these books, which are listed in Further Reading at the end of this book).

It is good to remember that the nutritive value of natural foods does not vary a great deal for a particular variety of the same food from one country to another. But there is a great variation in the composition of prepared foods such as bread, biscuits, cakes, etc., due to variation in recipes and the basic ingredients used from one region to another.

Table 1.1: Food Composition at a Glance[1]

(Approx. Group Values per 100 g. E.P.)

Foods	*Moisture*	*Calories*	*Protein (g)*	*Vit. A (mcg.)*	*Vit. C (mg)*	*Minerals & Vit. B-Comp*
Cereals– rice, Wheat, bajra, Jowar	10	340	7 to 12	—	—	Some
Dals, legumes	10	340	17 to 25	—	—	Some[2]
Milk	85	70	3	48	—	Some[3]
Eggs	75	170	13	960	—	Some
Meat– fish, poultry	75	100–190	18	Some	—	Some
Leafy & Orange-yellow Vegetables & Fruits	90	20	2	1,800	30	Some
Fruits– Vit. C-rich	85	50	1	Some	50	Some
Other vegetables	90	30	2	Some	Some	Some
Other Fruits	85	50	1	Some	Some	Some
Roots & tubers	60–85	50–100	1	Some	Some	Some
Oils & Fats	0	900	—	750[4]	—	—
Sugar, jaggery	0	400	—	—	—	—

1. Please refer to Appendix F for individual composition of foods.
2. Rich source of iron and B-complex.
3. Rich source of calcium and riboflavin.
4. Ghee contains this amount and vanaspati is fortified to provide this amount of Vit. A.

Food Exchange Lists

In 1950, the American Diabetes Association and the American Dietetic Association collaboratively developed a system of food lists to help diabetic patients to select foods in their diets. Similar food lists were prepared in other countries to help diabetics to choose their foods. In India also food lists were prepared based on the foods available and our meal pattern. Since India is a large country there are three major agencies that have evolved their food exchange lists. These agencies are dietetic departments

of major regional hospitals, the Home Science colleges, which train dietetic students, and the dietetics department of the National Institute of Nutrition. These are presented in Appendix B.

Each of the list includes a group of foods, which supply about the same calories in the portion indicated. Each food choice within a list is called an exchange. It represents an amount of food that has about the same macronutrient value as other foods in the same group.

The exchange lists are very useful tools in diet planning in hospitals and in personal diet management in the home.

Nutrient Density

It refers to the quantity of one or more nutrients supplied by a food in reference to its calorie content. For example, if one compares the protein content of isocaloric portions of *dal,* bread and milk, one can see that *dal* has the highest nutrient density for protein, milk next and bread the least.

	Calories	*Protein*
Dal	85	5.5
Milk	85	4.0
Bread	85	2.4

Thus, nutrient density is an important aspect to be considered in selection of foods, especially in diets of children, pregnant women, nursing mothers and in therapeutic diets for patients.

Nutrient dense foods like low-fat milk, beans, *dals*, amla, oranges, carrots, spinach, chapatti, etc., do help balance less nutrient dense choices we often make, like *mithai* and chips. The latter tend to supply energy as sugar and fat, but little else.

How will you be a responsible nutrition student?

First, use what you learn in nutrition and benefit yourself. It will help you to look better, feel better and work effectively. By practising what you learn, you will set a good example for others.

Secondly, take care of nutrition of your family. Help the children in the family to develop good food habits, the adults to make good food choices in eating and seniors to meet their changed needs.

Thirdly, as a professional you will be able to help people, who seek your advice, to make appropriate changes to improve their food choices to improve their well-being.

Lastly, as a member of the community, you can influence the choice of foods served in social events.

Study Questions

1. Explain the terms nutrition, nutrients, nutritional care, optimum nutrition and undernutrition.
2. How is food related to health?
3. Discuss the physiological functions of food.
4. “Food is also used to satisfy social and psychological needs”. Explain this statement by giving examples.
5. What do you understand by adequate nutrition?
6. Explain the concept of exchange lists.
7. What is nutrient density?
8. How will you use your knowledge of nutrition?

CHAPTER

Digestion, Absorption and Utilisation of Nutrients

2

Introduction

OUR BODY is synthesised from the food we eat. It is made of a complex structure of cells, tissues and organs. How does this change from food to our body structure occur? All the changes that occur in the food from the time we eat it, to its use in the body and discarding of the waste matter are known as metabolism. One can describe metabolism of each nutrient separately to ensure ease of understanding. But actually it occurs in a correlated systematic manner.

Basic concepts of biology and chemistry need to be understood in the study of nutrition. Let us review these.

Concepts in Biology: The study of nutrition begins with the cell, the basic unit of our body. All the nutrition processes, which we refer to as metabolism, take place in the cell. Metabolism includes both **anabolism** and **catabolism.** Anabolism involves synthesis of compounds needed for use in the body. Breakdown of complex substances to simpler ones is known as catabolism. Thus cells are able to take up nutrients, synthesise substances they need and eliminate wastes. The energy release and its utilisation occurs in the cell.

There are many kinds of cells in the body, each type specialises in carrying out certain functions required by the body.

Cells are grouped together to form a tissue. Muscle, nerve, epithelial and connective tissue are examples of various tissues.

Two or more tissues are combined to form an organ, which carries out a specific function. Heart, lungs and kidneys are examples of organs.

Cells are made up of several parts. Each part has an appropriate structure and a specific function. Two main parts of the cell are the nucleus and the protoplasm, which surrounds the nucleus and is called cytoplasm (Figure 2.1).

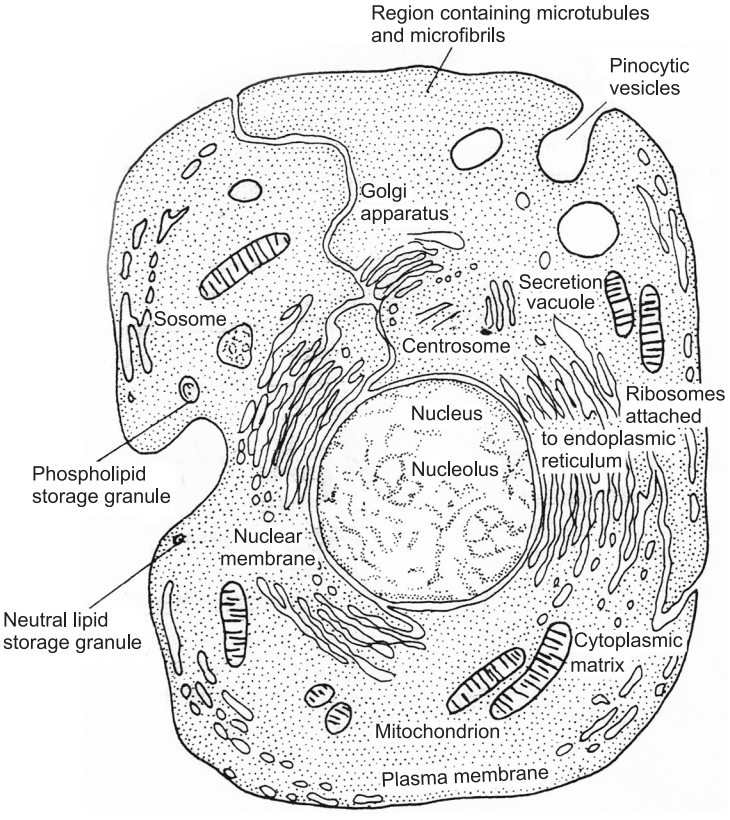

Figure 2.1: Diagram of a typical cell based on electron micrographs. (Adapted from "The Living Cell" by J. Bracket. Copyright © 1961 by Scientific American, Inc. All rights reserved.)

The nucleus controls the functions of the cell; the metabolic activities of the cell are carried out by the cytoplasm.

The deoxyribonucleic acid **(DNA)** in the cell nucleus contains the pattern for each of the different proteins in the body. The ribonucleic acid **(RNA)** directs the actual protein synthesis in the ribosomes, using the information stored in the DNA. This process, which is directed and controlled by DNA, is the key to nutrition.

All the components, which form nutrients, come from food. Our genes determine the nutrients that can be synthesised in the body and those which need to be provided preformed in the food.

The small channels in the cytoplasm, called endoplasmic reticulum, transport nutrients and their metabolites throughout the cytoplasm. The enzymes, which function in metabolism, are found in the membranes surrounding the channels.

The **mitochondria** and **lysosomes** are also present in the cytoplasm. Mitochondria release the energy provided by the carbohydrates, fats and proteins and transfer it to an energy acceptor (ATP). The ATP transfers the energy as needed wherever work is being done. Therefore the mitochondria are known as the 'power plants' of the cell.

Lysosomes contain enzymes, which function in the breakdown of proteins and other compounds. Lysosomes help to digest foreign matter that may have entered the cell and thus protect the body from their harmful effects.

Chemistry: Our body and the food that nourishes it are made of chemical elements. Therefore knowledge of the chemical elements and their behaviour is basic to the study of nutrition.

Elements: Elements are fundamental units of matter, which have characteristic properties. The Periodic Table contains all the elements. Of the 106 known elements, 92 occur in nature, the rest are of synthetic origin. Examples of elements are oxygen, carbon and iron.

Atoms: The smallest constituent part of an element is an atom. There are smaller particles, which are parts of an atom. The **proton** (+vely charged) and **neutron** (uncharged) particle are located in the nucleus of the atom. In the shells (orbits) around the nucleus, the **electron,** a negatively charged particle is found.

Atoms of one element can combine with atoms of another element to form a compound. For example, water contains two atoms of hydrogen and one of oxygen (H_2O).

Molecule: Chemical elements exist as molecules, a basic unit, which can be made up of atoms of one or more elements. Thus we have a molecule of oxygen (O_2) with two atoms of oxygen, while sodium chloride (NaCl) contains one atom of sodium and one atom of chlorine.

Ion: An electrically charged atom, group or molecule is called an ion. A positively, charged ion is called a **cation,** and a negatively charged one an **anion.** K^+ is an example, of a positive atom and Cl^- is a negative atom; potassium chloride (KCl) is a neutral compound.

Isotopes: Some elements have isotopes, that is they exist in two forms, with two different atomic weights; for example, the atomic weight of carbon is 12, its isotope has an atomic weight of 14 (^{14}C). The ^{14}C isotope of carbon is naturally radioactive.

Acids, Bases, pH: A chemical compound, which when dissolved in water yields hydrogen ions (H^+), is an acid. There are two types of acids, inorganic acids and organic acids. Hydrochloric, sulfuric and phosphoric are inorganic acids. Organic or carboxylic acids contain one or more carboxyl groups (COOH) in their molecule. Fatty acids and amino acids are important organic acids in nutrition.

Hydrogen ion concentration is the amount of hydrogen ion (H^+) per unit volume of an aqueous (water) solution. It is referred to as pH.