UNIT 2 THE MACRONUTRIENTS-I: CARBOHYDRATES AND WATER

Structure

2.1 INTRODUCTION

You know that nutrients are essential constituents of food that must be supplied to the body in suitable amounts. There are around 40 essential nutrients which (based on their chemical structure and properties) are placed in five categories. These are carbohydrates, fats, proteins, vitamins and minerals. Water has the unique status of a food as well as that of a macronutrient.

You encountered the two terms—macronutrient and micronutrient in Unit 1. Most of the weight of the food is due to carbohydrates, proteins, fats and water. These nutrients are collectively known as macronutrients. Vitamins and minerals contribute to only a small fraction of the total weight of the food. These are termed as micronutrients. Our body needs carbohydrates, fats, proteins and water in much greater amounts than vitamins and minerals. But vitamins and minerals or micronutrients are as essential for the body as macronutrients.

Units 2 and 3 of this Block and 4 and 5 of Block 2 will introduce you to the fascinating world of macronutrients and micronutrients. Entry into this world of nutrients will require a little extra effort on your part. You will be required to know the basic concepts of chemistry for understanding the nature and functions of nutrients. All the necessary basic chemical terms are explained in these units. Try to understand one term before going on to the other. Do remember that these units will lay the foundation for other units of the course. So concentrate here.

This unit will first take a look at how food is handled by the body i.e. the processes of digestion, absorption and utilization. It will then move on to a discussion on two specific macronutrient categories—carbohydrates and water. You will learn about the nature, food sources and functions of these nutrients. In addition you will be introduced to the processes whereby the body handles carbohydrates and water.

Objectives

After studying this unit, you will be able to:

- describe the processes of digestion and absorption of food
- discuss the concept of utilization of food in simple terms
- distinguish between available and non-available carbohydrates
- describe the chemical nature of carbohydrates and water
- list the food sources of carbohydrates and water
- state the role of carbohydrates and water in the body and
- describe the processes of digestion, absorption and utilization of carbohydrates in the body

2.2 DIGESTION, ABSORPTION AND UTILIZATION OF FOOD—AN OVERVIEW

You already have an idea of the processes of digestion and absorption. What is the purpose of the process of digestion? It is through this process that the complex substances in food are broken down into simpler substances which the body can take in and use. Some of these complex substances such as carbohydrates, proteins and fats undergo some change during digestion. However, water, minerals and vitamins present in the food can be absorbed directly without undergoing any digestive change. Digestion and absorption take place in the digestive tract of the body. Look at Figure 2.1. It shows you the essential parts of the digestive tract.

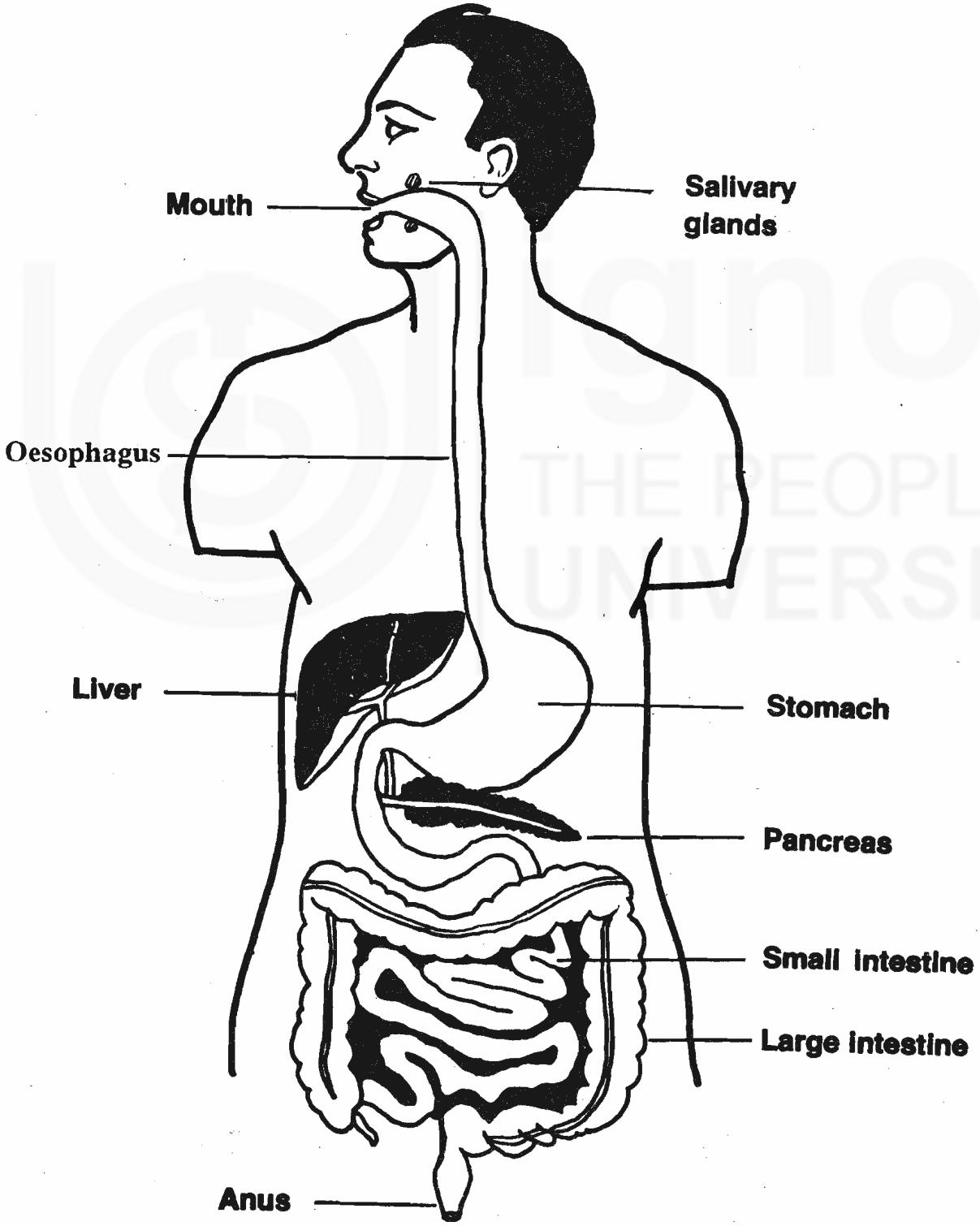

Fig. 2.1 The digestive system

Food takes the following path in the digestive tract.

Mouth → Oesophagus → Stomach →
Small intestine → Large intenstine →
Rectum → Anus

The liver and pancreas are not a part of the digestive tract but they secrete certain juices or secretions which do play a role in the process of digestion and absorption of food.

The whole process of digestion is accomplished in the time food remains in the digestive tract. The process of digestion starts from the ingestion or intake of food in the mouth. From here food passes to the other parts of the digestive tract. Each of these parts of the digestive tract (except the oesophagus, rectum and anus) contain some kind of digestive juice. These juices are either secreted by that particular part of the tract or poured in from the other organs or glands of the body such as liver and pancreas. These digestive juices contain chemical substances known as enzymes. Enzymes are proteins which help chemical reactions to proceed faster. They bring about changes in food substances without themselves undergoing any change.

DIGESTION OF FOOD : Let us now have a look at the overall process of digestion. Digestion takes place step-by-step at various sites in the digestive tract as you will learn from the following discussion.

- **Mouth :** As you have already noticed, the process of digestion begins in the mouth where food is chewed by the teeth and mixed with saliva. While the food is still in the mouth, it is acted upon by an enzyme, amylase, which acts only on cooked carbohydrates and partially digests them or breaks them up into smaller units.
- **Stomach :** The chewed food mixed with saliva then passes into the stomach through the tube-like structure called the oesophagus. Here it gets mixed with the digestive juice present in the stomach called gastric juice. Besides enzymes and water, gastric juice also contains small amounts of an acid called hydrochloric acid which makes it acidic in nature. Mixing of food with the gastric juice converts the food into a thin soup-like consistency. Gastric juice contains an enzyme which acts on proteins and brings about their partial digestion. Other nutrients in food remain chemically unchanged.
- **Small intestine :** The next stop in the digestive tract is the small intestine. The partially digested mass of food passes from the stomach into the small intestine. The small intestine not only contains intestinal juice (which is secreted from the small intestine itself) but also secretions from the liver and pancreas. The secretion from the liver is called bile and from the pancreas is known as pancreatic juice. Bile aids in the digestion and absorption of fats (you will learn about the role of bile in fat digestion in Unit 3). Both pancreatic and intestinal juices contain enzymes which break down fats, proteins and carbohydrates into simpler substances. These simple substances ultimately reach the bloodstream.
- **Large intestine :** The food which is not absorbed in the small intestine along with a large amount of water passes on to the large intestine. Here most of the excess water is reabsorbed and the remaining water and solid matter is eliminated from the body as faeces.

ABSORPTION OF FOOD : Where is food absorbed? You would have realised by now that absorption takes place in the small intestine. The end products of digestion or the nutrients present in the small intestine can be used by the body only when they enter the bloodstream. This process of movement of digested food or nutrients across the intestinal wall to the bloodstream is termed absorption of food. The wall of the small intestine is made up of numerous folds or finger-like projections known as villi. The presence of these villi tremendously increase the total area from which absorption can take place. Most of the nutrients are absorbed from the upper part of the small intestine though some are absorbed from the l[illegible]sorption. Figure 2.2 gives a summary of the processes of digestion and abs[illegible]

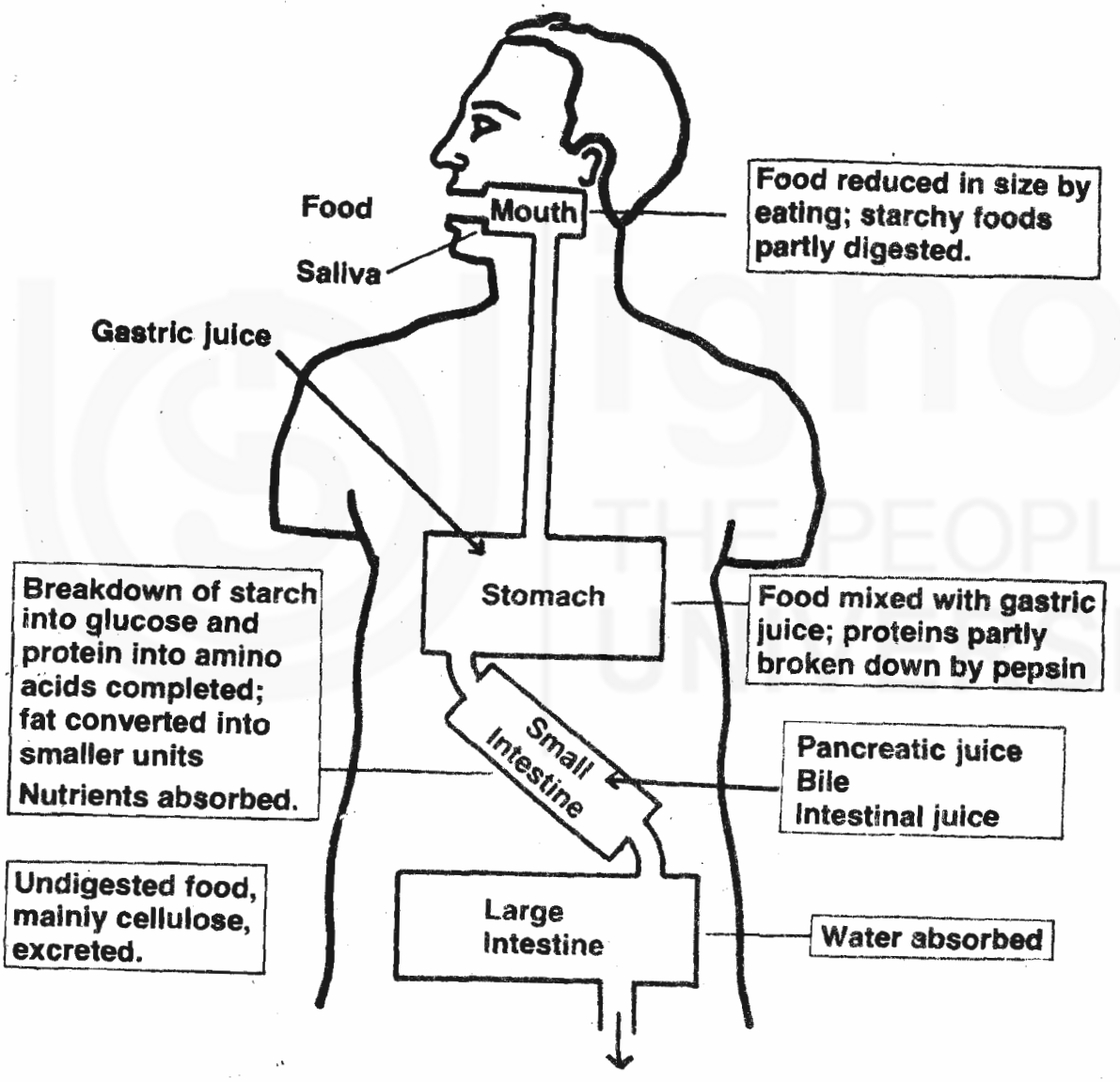

Fig. 2.2 Summary of the digestive Process

As you know, the end products of digestion move into the bloodstream after absorption. The blood circulating in the body and, therefore, the nutrients it carries reaches every cell of the body. Blood can, therefore, be considered somewhat like a bus carrying passengers from one stop (i.e. the intestine) to another (i.e. the cell) (Figure 2.3). Once they reach the cell, the nutrients perform their specific functions.

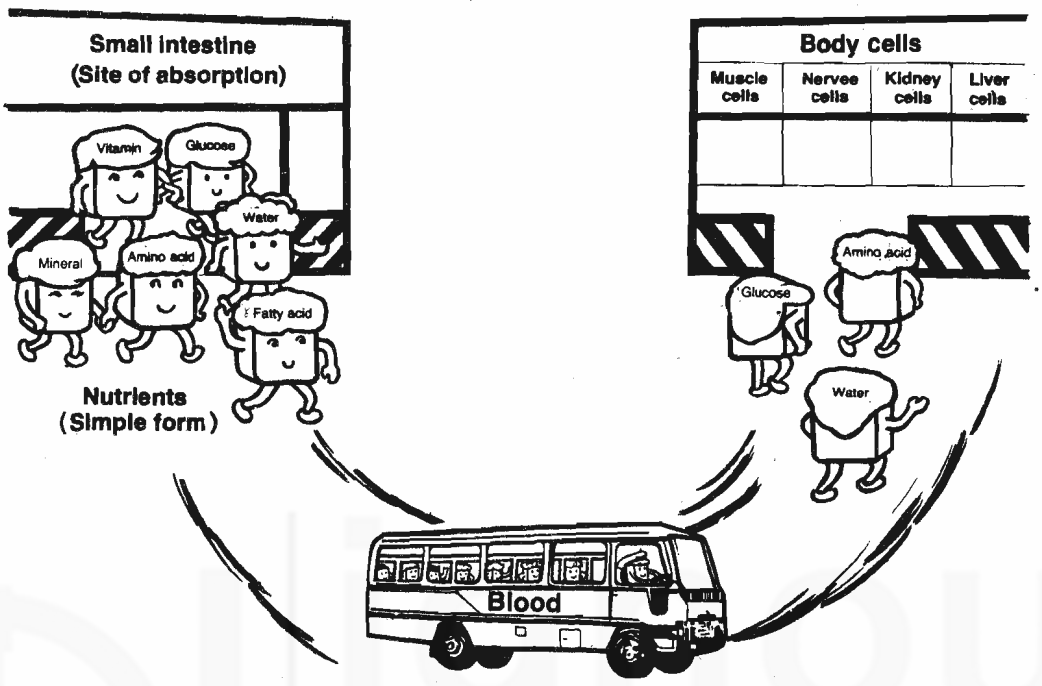

Fig. 2.3 Transport of nutrients

UTILIZATION OF FOOD : How is food utilized? In order to be utilized for specific functions the absorbed end products or the nutrients from the food we eat further undergo chemical changes. They are either further broken down to release energy or are used to form more complex substances. These substances can then be used to manufacture more complex substances or can be stored in the body. We use certain terms to refer to these processes. Let us learn these terms.

Metabolism is a general term. It is just a small word referring to all the chemical changes that take place in the cells after the end products of digestion are absorbed You know it is of two types—breakdown of complex substances into simpler ones and manufacture of complex substances from simple ones. We have two terms referring to each of these processes. Let us learn these.

Anabolism is the term used to refer to all the chemical reactions by which simple substances are used to manufacture more complicated ones and *catabolism* includes all the chemical reactions by which complex substances are further broken down to simpler components.

In Units 2 and 3 you will learn the mechanism of digestion, absorption and utilization relating to carbohydrates, fats and proteins separately. It will provide you a better understanding of the same. Let us now discuss the nature, functions, food sources and processes of digestion, absorption and utilization relating to carbohydrates and water.

2.3 CARBOHYDRATES

The term carbohydrate refers to a large family of organic compounds essentially made of three elements i.e. carbon, hydrogen and oxygen. If you are not familiar with the terms element and organic compound read the information given in Box 2.1.

Box 2.1 : Elements and Compounds

Chemically all nutrients are made of *elements.* There are around 103 naturally occuring elements. Some of these are essential for living cells. These include/ Hydrogen(H), Carbon(C), Nitrogen(N), Oxygen(O), Phosphorus(P), Sodium(Na), and Calcium(Ca). All elements are made up of small units called atoms.

Atoms of one element combine with the atoms of another element to form a compound. Note that atoms present in a compound cannot be separated. For example, water (H_2O) is a compound made up of two atoms of hydrogen and one atom of oxygen. All compounds containing carbon (except a few like carbon dioxide) are called *organic compounds.* All other compounds which do not contain carbon are *inorganic compounds.* According to these definitions *carbohydrates, proteins, fats and vitamins are organic compounds* (i.e. they essentially have carbon as one of the elements). *Minerals are inorganic elements; water is an inorganic compound.*

Carbohydrates are widely distributed in plant foods. They are mainly present in these foods in the form of three types of compounds called sugars, starches and fibre. All these carbohydrates are made up of some basic simple units. One prominent example of a basic unit is *glucose.* Other examples are fructose and galactose (Figure 2.4).

Table sugar (cane sugar) which we commonly use in our houses is a carbohydrate made up of two basic units i.e. one unit of glucose and one unit of fructose. On the other hand, a starch molecule is very large. It is made up of several basic units of glucose linked together. These chains of glucose can be straight or branched. Examples of foods rich in starch are rice, wheat, maize and tapioca.

Fibre, like starch, is made up of a number of basic units. The term fibre includes several substances. Cellulose is one example. It is a substance made up of several glucose units. How, then, is it different from starch? It is the type of linkage between glucose units in cellulose that makes all the difference.

All these types of carbohydrates i.e. sugars, starches and fibre can also be classified as available and non-available carbohydrates. Carbohydrates like sugars and starches are digestible in the human digestive tract and hence can be made available to the body for its functioning. These carbohydrates are termed as available carbohydrates. Cellulose and certain other large carbohydrate molecules that cannot be digested in the human digestive tract are collectively referred to as fibre or non-available carbohydrates.

The discussion in Section 2.3.1 is on available carbohydrates and 2.3.2 on non-available carbohydrates. *In this unit the term carbohydrate is used for available carbohydrates and fibre for non-available carbohydrates.*

2.3.1 Available Carbohydrates

You will now learn various aspects relating to sugars and starches i.e. the available carbohydrates.

Food Sources : Which foods provide good amounts of carbohydrate? The list includes cereals and millets, roots and tubers, some fruits, sweeteners like cane sugar, jaggery and honey. You will find more details in Table 2.1. Cereals and millets are the main source of carbohydrates in Indian diets. All cereals like wheat, rice, and millets e.g. jowar, bajra and ragi contain considerable amounts of starch. So do roots and tubers like potato, tapioca, sweet potato, yam and colocasia. Fruits like mango, banana, sapota are, however, rich in carbohydrates in the sugar form, Cane sugar or cube sugar and other sweeteners like honey and jaggery are 95 per cent to 100 per cent carbohydrate (sugar form).

Pulses also contain substantial amounts of carbohydrates. However, pulses are more important in our diet as sources of protein.

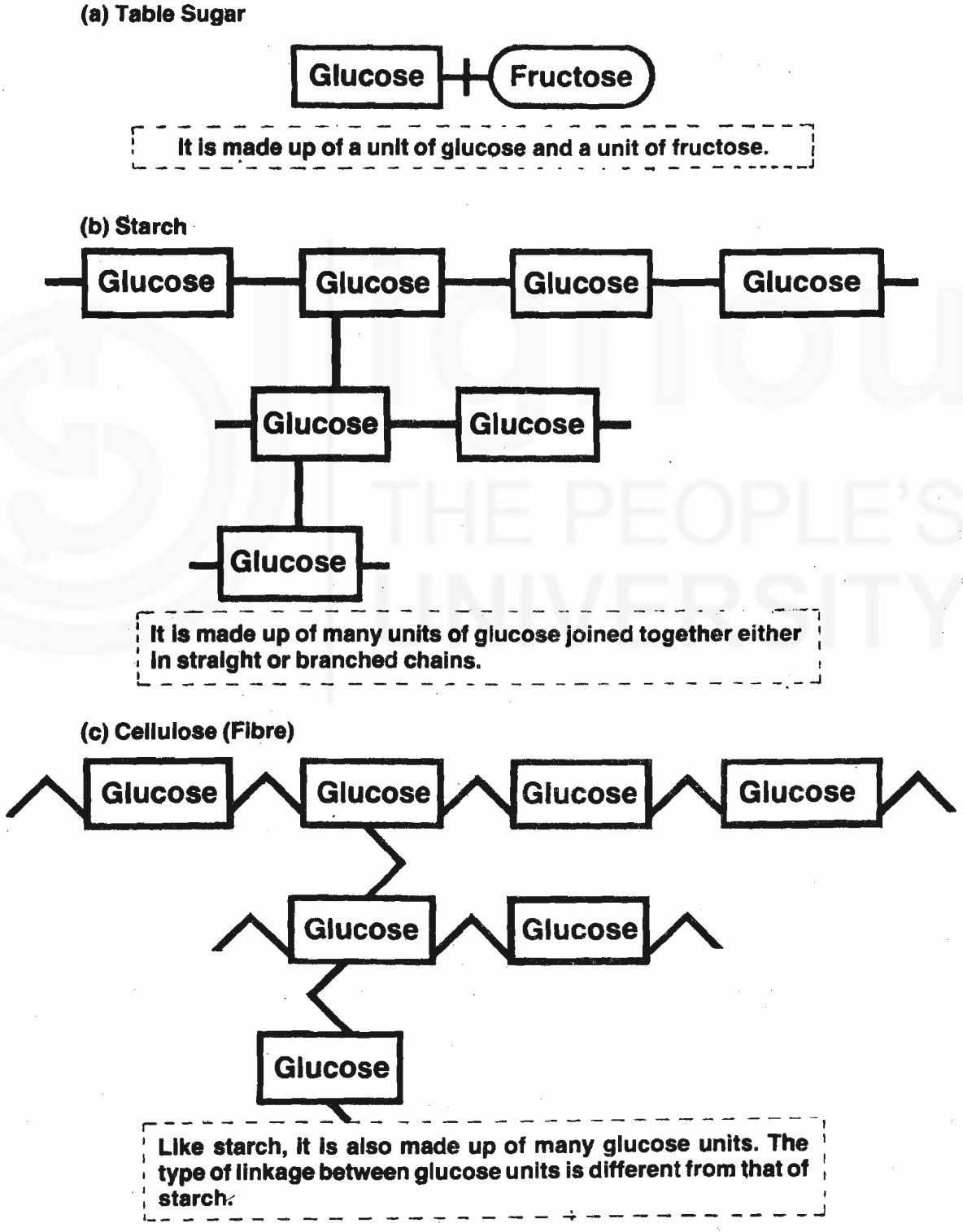

Fig. 2.4 Categories of carbohydrates

Table 2.1 : Carbohydrate—rich foods

Foodstuff	Carbohydrate content (g) (per 100 g edible portion of food)
Sugars:	
Cane sugar	99.4
Honey	79.5
Jaggery (cane)	95.0
Cereals:	
Wheat	71.2
Rice (raw, milled)	78.2
Roots and tubers:	
Potato	22.6
Sweet potato	28.2
Tapioca	38.1
Fruits:	
Banana (ripe)	27.2
Sapota	21.4
Mango (ripe)	16.9

Source : *Nutritive Value of Indian Foods* by C. Gopalan, B.V Rama Sastri and S.C. Balasubramanian; revised and updated by B.S. Narasinga Rao, Y.G. Deosthale and K.C. Pant; National Institute of Nutrition (1989)

Functions : Some of the important functions of carbohydrates are listed below

1) **Energy-giving function :** The chief function of carbohydrates is to furnish energy for the working of the body. One gram of carbohydrate provides approximately 4 kilocalories (Kcal). Carbohydrate foods are widely distributed in nature and are the cheapest sources of energy. They usually provide 60-70 per cent of the total calories in our diets. The kilocalorie is the unit of measurement of energy. One kilocalorie is the amount of heat required to raise the temperature of 1 kilogram of water by 1 degree centigrade (°C). Do note that in nutrition, kilocalorie and calorie mean one and the same thing.

2) **Protein-sparing action :** Though proteins can be broken down in the body to meet the energy need, this is not their chief function. You will learn more about the functions of proteins in Unit 3. An insufficient amount of carbohydrates in the diet will force the body to break down proteins for releasing energy instead of using them for the body's growth and development. Carbohydrates, if taken in sufficient amounts to meet the energy needs of the body, spare proteins for their important basic role in the body i.e. supporting growth and body-building. This particular act of sparing proteins for other functions is termed as the protein-sparing action of carbohydrates.

3) **Utilization of fats :** Some amount of carbohydrate is needed for the proper utilization of fat in the body. Presence of carbohydrates in the diet prevents the body from breaking down too much fat for energy. In case of deficiency of carbohydrates in the diet, more fat will be broken down to meet the energy requirements of the body. Why is this harmful? The reason is that excessive fat breakdown can result in accumulation of by-products of fat metabolism. This accumulation causes a problem and can affect health.

Check Your Progress Exercise 1

1) What do we mean by protein-sparing action of carbohydrates?

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2) How are starches different from table sugar?

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Digestion, absorption and utilization : Digestion of carbohydrates involves breakdown of starch and sugars like common table sugar in the diet to their simplest unit namely, glucose. Other carbohydrate substances like dietary fibre present in whole grains, vegetables and fruits cannot be digested by human beings because the stomach and intestines do not have the necessary chemical substances called enzymes to do this job.

The digestion of carbohydrates begins in the mouth itself. Saliva contains an enzyme called amylase which is capable of breaking cooked starch into smaller units. However, the time available for this enzyme to break down the starch in the mouth is too short to allow for any significant amount of conversion to take place. The longer one chews the food, the more the digestion of starch. There are no carbohydrate-digesting enzymes in the stomach. Thus the principal site of carbohydrate digestion is the small intestine. The major carbohydrate-digesting enzyme present here is an amylase secreted by the pancreas. This enzyme is capable of acting on both raw and cooked starch and converts it into smaller units. The next phase of carbohydrate digestion takes place within the cells of the small intestine where three important enzymes complete the process of digestion. These enzymes act on sugars and partially digested starch and ultimately break them up into the simple basic units i.e. glucose, fructose and galactose.

All the simple sugar units are taken to various body tissues and cells through the bloodstream and are ultimately converted to glucose. Some amount of glucose remains in the blood as blood sugar and is drawn upon by the body cells whenever needed. In the body cells glucose is mainly burnt to release energy. You know that oxygen is necessary for burning. Several substances are burnt in the body using oxygen. This process of burning of substances in the body is called oxidation. Hence the process of burning of glucose to release energy can also be termed oxidation of glucose. However, you must remember that burning or oxidation of glucose is not a single reaction. It takes place in several steps.

The extra glucose (which is not burnt to release energy) is converted to a substance called glycogen which is subsequently stored in the liver and muscles. Glycogen is made of long chains of glucose molecules. Glycogen can be broken down to release glucose whenever needed. But only a limited amount of glucose can be stored in the body as glycogen. Once the limit of glycogen storage is exceeded the remaining excess glucose is converted into fat and is stored in the body.

Check Your Progress Exercise 2

1) Why are substances like cellulose or dietary fibre indigestible in the human digestive tract?

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2) Fill in the blanks.

a) The principal site of carbohydrate digestion is the.....

b) ..... .and..... .are the major sources of

carbohydrates in our diets.

c) Starch is an example of a carbohydrate built up of several..... units.

d) One gram of carbohydrate provides approximately .....Kcal.

e) ..... is the storage form of glucose in the body.

2.3.2 Non-available Carbohydrates

If you have gone through the health columns of leading newspapers or magazines, you may have come across the term *fibre*. Fibre is nothing but non-available carbohydrate.

Is fibre a nutrient? What role does it play in our body? Let us try to answer these questions. Fibre, as you are aware, refers to a number of indigestible carbohydrates like cellulose present in plant foods. Research in this field shows that though these indigestible components of food are not available to the body, yet they play an important role in the regulation of some body processes. This is the reason why they are considered regulatory substances

Functions : Let us now study the role of fibre in some detail.

1) **Satiety value :** You know fibre cannot be broken down chemically in the body. However, in the digestive tract some components of fibre absorb water. They swell up and make the food residue bulky which gives a feeling of fullness or satisfaction.

2) **Elimination :** Fibre also helps in the easy elimination of unabsorbed food in the form of stools or faeces from the body. Fibre present in stools holds water, makes them softer and hence helps in their easy elimination. This particular function of fibre makes it useful for preventing or relieving constipation. Hence, it is a good idea to eat a diet that has generous amounts of fibre sources like cereals, pulses and vegetables.

3) **Prevention of diseases like cancer, diabetes and heart disease :** Some research studies have indicated that fibre does play a role in prevention of diseases like heart disease, diabetes, cancer of the colon i.e. the large intestine.

Food Sources : Fibre is present in the outer covering of cereals and pulses. The wheat grain, whole wheat flour and whole pulses (with outer husk) like black gram, rajmah, lobia, contain appreciable amounts of fibre. Refined cereals like maida and suji and washed dals (without outer covering or husk) do not contain much fibre.

What do we mean by the terms "whole cereal" and "refined cereal"? You will find that all grains have a common structure (Figure 2.5). They have three main parts— the outer covering or the bran, the germ or the embryo (the part which grows into a new plant) and the endosperm (which stores food for the growing embryo). The grain with the outer covering (or its product having the outer covering in it) is termed whole grain cereal (or whole cereal product). For example, when whole wheat is milled (ground in machines) to form atta, most of the bran remains in it. Thus, atta or whole wheat flour is a whole cereal product.

Maida and suji are produced by further cleaning or refining (removal of coarse particles of bran and germ) of atta and are thus known as refined cereals.

Fibre is also present in the outer skin and seeds of most vegetables and fruits. However, some of the vegetables and fruits are particularly rich in fibre. Some examples are lotus stem, green leafy vegetables, ladies finger, peas, beans, brinjal, guava, oranges and amla. Animal foods like milk, milk products, meat, fish, poultry do not contain fibre.

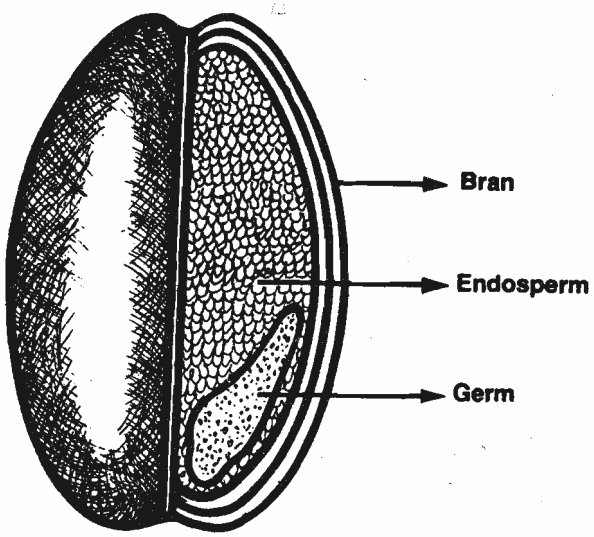

Fig. 2.5 Parts of the cereal grain

Check Your Progress Exercise 3

1) What is the role of fibre in relieving constipation?

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2) Fill in the blanks.

a) .....and.....are termed refined cereals.

b) Fibre is the term used for.....carbohydrates such as.....

c) .....and.....are some of the rich sources of fibre.

2.4 WATER

Water is essential for life. In fact, one can survive without food for weeks but not without water. Water is a macronutrient made of two elements—hydrogen and oxygen. A molecule of water contains two atoms of hydrogen and one atom of oxygen in other words the ratio is 2:1. Remember water is an inorganic compound.

You would have noticed that water has earlier been referred to as a food. This is because water in the form in which we consume it contains other nutrients like sodium and potassium which belong to the mineral category.

Functions: What role does water play in our body? Many of the functions of water are self-evident. Try to think. You will be able to list some of them. Important functions of water are given below. You can cross check your answer with these.

1) Water is the *major component of our body.* It makes up approximately 60 per cent of the total weight of an adult and almost 75 per cent in the case of the infant. It serves as the major and essential component of all cells and tissues though the amount of water present in different body tissues varies.

2) Water is the *medium of all body fluids* including blood, saliva, digestive juices, urine, faeces, sweat or perspiration.

3) Water plays an important role in the *regulation of body temperature.* Under normal circumstances your body temperature is maintained at 98.4° F or 37° C. You know that heat is produced in the body by the burning of carbohydrates, fats and proteins. Water helps to distribute this heat throughout the body. Some amount of water is lost from the body by evaporation and cools it down. This is because the water uses the body heat to evaporate. Thus, extra heat from the body is lost and body temperature is maintained.

4) Water is a *universal solvent.* This means it dissolves a variety of substances including all the products of digestion and carries them to various parts of the body via blood. Similarly, it helps in the removal of the waste products from the body. This property of water makes it essential for all the chemical reactions taking place in the body.

5) Water bathes the body cells and keeps them moist. Hence it acts as a *lubricant.* Water present in saliva and other digestive juices helps in the passage of food down the digestive tract. It is also an important lubricant for the joints.

Water does not undergo any digestive change in the body and is absorbed as such.

Sources : Our body gets water mainly by :

a) *The ingestion of water in the form of liquids :* This includes water which we drink daily as such or part of beverages like tea, coffee, fruit juices and aerated drinks.

b) *The ingestion of water in the form of solid foods :* Water is present in various foodstuffs in hidden or invisible forms. The water content of foods varies widely. Table 2.2 gives water (moisture) content of some of the foodstuffs.

It is vital that the water we drink is safe and free from germs causing water-borne diseases such as diarrhoea, dysentery, and cholera. Clean and safe drinking water is absolutely necessary.

Table 2.2 : Moisture Content of Some Foodstuffs

Foodstuffs	Moisture content (g) (per 100 g of edible portion)
Vegetables	
Spinach	92.1
Pumpkin	92.6
Peas	72.1
Fruits	
Apple	84.6
Milk	
Cow's milk	87.5
Cereals	
Wheat	12.8
Rice (raw, milled)	13.7
Pulses	
Bengal gram	9.8

Source : *Nutritive Value of Indian Foods* by C. Gopalan, B.V. Rama Sastri and S.C. Balasubramanian; revised and updated by B.S. Narsainga Rao, Y.G. Deosthale and K.C. Pant; National Institute of Nutrition (1989)

c) *Water formed in the body from the metabolism of nutrients.* Some amount of water is formed in the body during the various chemical reactions involved in the the metabolism of carbohydrates, as you have studied earlier. The reactions involved in fat and protein metabolism also contribute water to the body.

Thus, the total water available to the body is obtained through these three sources i.e. drinking water and beverages, foods and the metabolism of nutrients in the body.

During the course of utilization of water for various body processes some amount of water is also lost from the body through the kidneys, skin, lungs and digestive tract.

A significant amount of water is lost through the skin in sweat or perspiration. Water is lost from the kidneys in the form of urine. A small amount of water is also lost from the digestive tract in saliva and faeces. The air we breathe out from the lungs also contains some amount of water. Normally the body maintains a balance between intake of water i.e. ingestion and loss of water from the body i.e. excretion. This is termed water balance.

Check Your Progress Exercise 4

1) What is the meaning of the term 'water balance?

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2) Fill in the blanks.

a) Our normal body temperature is.....

b) Water is the universal.....

c) Water makes up approximately ..... per cent of the total weight of an adult.

2.5 LET US SUM UP

Food provides five major categories of nutrients i.e. carbohydrates, fats, proteins, minerals, vitamins, and water. Water, as you know, can be termed as a food as well as a macronutrient. Each of the nutrients has specific functions in the body. Some of these are known as macronutrients while others are called micronutrients.

The discussion in this unit is on two categories of macronutrients i.e. carbohydrates and water.

Carbohydrates are classified into three major categories—starch, sugar and fibre. Carbohydrates are also classified as available (starch, sugar) and non-available carbohydrates (fibre). Available carbohydrates i.e. sugars and starches are digestible in the human body. The chief end product of digestion of sugar and starches is glucose. The main function of available carbohydrates is to furnish energy for the functioning of the body. The non-available carbohydrates are indigestible in the human digestive tract but have many beneficial functions in the body like increasing the satiety value of food, helping in easy elimination of faeces or waste products from the body and the prevention of diseases like heart disease, diabetes, cancer of the colon i.e. large intestine.

Water (like carbohydrates, proteins and fats) is a major component of food. A molecule of water is made of two atoms of hydrogen and one atom of oxygen. Water is absorbed as such without any digestive change. Water has many important functions in the body. It is the major component of all cells and tissues of the body. It is the medium of all body fluids, helps in transport of many substances and excretion of waste products from the body. Water helps to regulate body temperature and keep it within the normal range.

2.6 GLOSSARY

Constipation : A condition of the body characterized by the difficult, delayed passage of stools

Enzyme : Protein substances present in living cells. Enzymes help chemical reactions to proceed faster. They bring about changes in other substances without themselves undergoing any change

Edible portion Most foods have both an edible portion (which can be eaten such as the flesh of fruits and vegetables) and a non-edible portion (which cannot be eaten like the seeds and outer skin of some of the fruits and vegetables). Some foods have a higher percentage of edible portion as compared to other foods. The nutritive value or nutrient content of the food is usually given on the basis of edible portion contained in them

Glycogen : The main storage form of carbohydrate in animals

Water balance : A balance in the body between the intake of water i.e. ingestion and loss of water i.e. excretion

2.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Both proteins and carbohydrates can be broken down in the body to provide energy. The main function of carbohydrates is to furnish energy for the body; this is not the case with proteins. The presence of carbohydrates in the diet takes care of the energy needs of the body and hence spares proteins for their chief function of growth and body-building. This function of carbohydrates is termed protein-sparing action.

2) Starch is a very large molecule which is made up of many basic carbohydrate units or glucose. It is made of long chains of glucose (either straight or branched) whereas the table sugar which we commonly use at home is a much smaller molecule and made up of only two basic units—one unit of glucose and one unit of fructose.

Check Your Progress Exercise 2

1) Substances like cellulose are termed indigestible because enzymes capable of bringing about their digestion are not present in the human digestive tract.

2) a) small intestine

b) Cereals and sugars

c) glucose

d) 4 Kcal

e) Glycogen

Check Your Progress Exercise 3

1) Dietary fibre present in food cannot be digested in the body. The unabsorbed food residue chiefly containing indigestible fibre absorbs water, gives bulk to the stools and helps in their easy elimination from the body. Thus, fibre plays a role in relieving constipation.

2) a) Maida and suji

b) blood glucose

c) Indigestible or non-available cellulose

d) whole cereals and pulses

Check Your Progress Exercise 4

1) Intake of water into the body from all three sources (i.e. water as such and in the form of beverages, water from foods, water produced in the body from the metabolism of nutrients) is termed ingestion. Some amount of water is lost from the body during the course of its utilization. This is termed excretion of water. Usually in normal conditions the body maintains a balance between ingestion of water and excretion of water. This is termed water balance.

2) a) 98.6°F or 30°C

b) solvent

c) 60-70 percent.