

## UNIT 3: CARBOHYDRATE

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### 1.0 Introduction

The unit of this course discussed the various nutrients in food. One of the nutrients is carbohydrate. Carbohydrate is an energy yielding nutrient, the largest nutrient in the food after water. It has been reported that carbohydrate accounts for about three fourths of the energy in the plants. This unit discusses this nutrient under classification, sources functions, requirement and consumption.

### 2.0 Objectives

At the end of this unit, you should be able to:

- List the classes of carbohydrates
- List the sources of carbohydrates
- List the functions of carbohydrates
- Discuss the consumption of carbohydrates.

### 3.0 Main Content

#### 3.1 Classification of Carbohydrates

Carbohydrates contain carbon, hydrogen and oxygen. There are always two hydrogen to one carbon. There are three classes of carbohydrates. They are:

- Monosaccharides
- Disaccharides
- Polysaccharides

##### a) Monosaccharides

These are simple sugars. The most important of them are glucose, fructose and galactose. Glucose is also known as grape sugar, dextrose and corn sugar. Fructose is found in fruits and vegetables, honey and sugar cane. Fructose is sometimes referred to as levulose. Galactose is the milk sugar and it is found in milk and milk products. All the Monosaccharides are end products of digestion of disaccharides and polysaccharides.

##### b) Disaccharides

Disaccharides are sugars that yield two monosaccharides on hydrolysis, (i.e. when they are broken down). The most common and important of them are, sucrose, maltose and lactose. Sucrose yields fructose and glucose when hydrolyzed. Sucrose is the cane sugar and it is found in fruit and plant juices.

Lactose is found in sugar cane or sugar beets. It is found mostly in milk from animals.

Lactose yields a molecule of galactose and a molecule of glucose.

Maltose consists of two molecules of glucose. It is found in germinating cereals where a specific enzyme reduces starch to maltose.

##### c) Polysaccharides

The polysaccharides yield more than two monosaccharides.

Polysaccharides are not simple sugars during digestion or any other form of breakdown.

The principal forms of polysaccharides are starch, dextrin, glycogen and cellulose. Others are insulin, agar, pectin and peptic substances. This latter group is of little or no nutritional importance to the body.

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The most important of the polysaccharides to human nutrition is starch. It is found in cereal grains, roots, bulbs and tubers. During ripening of fruits, the starch is converted to glucose.

During ageing of corn, the glucose is also converted to starch. During digestion, the starch is converted first to dextrin from dextrin to maltose and from maltose to glucose.

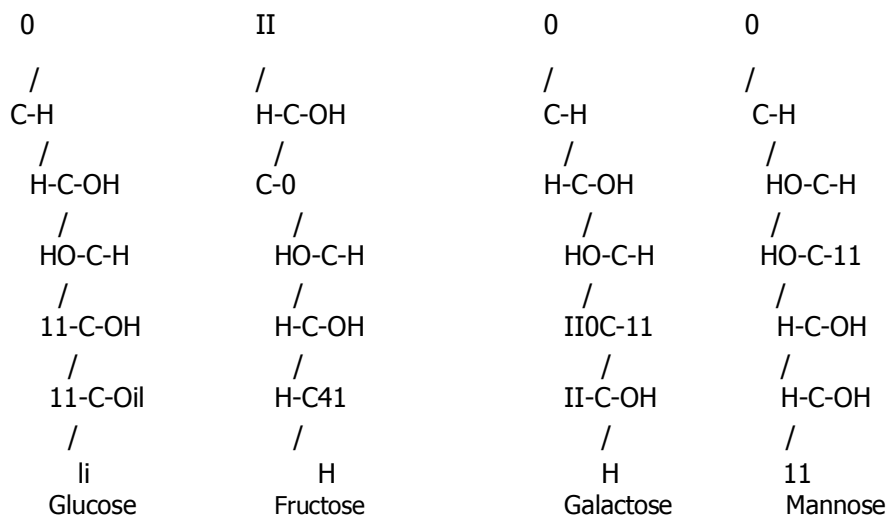
Dextrin, as you have just seen, is an intermediate product between starch and sugar,

Glycogen, also referred to as animal starch, is the form in which carbohydrate is stored in man and animal. It is found mostly in the liver with small amounts present in every body cell. Glucose is the end product of the breakdown of glycogen.

Cellulose is found in plants. It is an insoluble carbohydrate. It provides substantial amount of energy to ruminants since they can be digested by these ruminants.

Cellulose cannot be digested by man. However, it is good as roughages that are necessary for gastrointestinal health. Cellulose cannot be digested by man because man lacks cellulase.

It is necessary to show the molecular structures of some of the monosaccharides here so that the differences between them (structurally) may be seen. All the monosaccharides have molecular formula of  $C_6H_{12}O_6$ .



As you have learned, these monosaccharides will combine together with glycolytic bonds to form disaccharides and polysaccharides.

### 3.2 Functions of Carbohydrate

#### a) Source of Energy

Carbohydrate is used mainly as the source of energy in the body. It is the cheapest source of energy in the body. The glucose produced from the breakdown of carbohydrate is the only source of energy to the nervous tissue. Through the process of gluconeogenesis, glucose is produced from part of fat and from some amino acids. With this the nervous tissue can still obtain its need for glucose even without dietary intake of carbohydrate. However, when the glucose *level* in the blood falls below normal, the brain has problem with the supply of glucose — its only energy source. This can lead to symptoms of convulsions.

#### b) Dietary Essentials

Apart from carbohydrates, fat and protein could be used as a source of

energy. You will realize that people tend to consume less carbohydrate when the income increases. A diet should not be *completely* free of carbohydrate because recent evidence has shown that a diet of protein and fat, free of carbohydrate produces many undesirable symptoms. It is known that individual on carbohydrate free diet usually develops symptoms that resemble those of starvation. They are found to lose large amounts of sodium, unable to prevent breakdown of body protein, develop ketosis from the accumulation in the blood and urine of abnormal products from metabolism of fat. The individuals also experience dehydration, tiredness and loss of *energy*. Introduction of carbohydrate into such diets has been found to correct all the undesirable symptoms rapidly. This shows that carbohydrate is a dietary essential to the body. Ketosis is the excessive breakdown of protein.

c) It has been found that carbohydrates and some of the products derived from

carbohydrates serve as precursors of some important compounds in the body. Such compounds include nucleic acids and connective tissue matrix.

#### *Student Assessment Exercise 3.1*

3.1.1 What are the functions of carbohydrate in the body?

3.1.2 List the classes of carbohydrates and three examples of each of them.

### 3.3 Sources of Carbohydrate

Carbohydrates are mostly found in plants. of carbohydrate is milk — with lactose carbohydrate is also found in eggs.

The most important animal source content. Some small amount of

Carbohydrates are found in cereals, roots, vegetable.

tubers, corn, sugar-cane, fruits and

The cereals and cereal products have been found to form the largest fraction of the diet of man. These cereal and their products include wheat flour, pastries, bread, cakes, dry cereals and so on.

The many parts of the vegetables such as the root, tuber, leaves, fruits and seeds, contain carbohydrate.

Roots and tubers are also sources of carbohydrate. Yams, potatoes, cocoyams are all rich sources of carbohydrates.

Legumes are also good sources of carbohydrates. In fruits especially the ripe ones provide some amount of carbohydrates. Concentrated sugar such as sugars, syrups, molasses, jams and jellies, beverages, candies and honey are hood sources of carbohydrates.

### 3.4 Requirements of Carbohydrate

The body can perform its functions even when there is considerable low supply of carbohydrates. Hence it is not possible to establish a dietary standard for carbohydrate. Since the only source of fuel for the brain is from glucose, carbohydrate just be taken so that the brain can get **US** fuel. Diets that are free from carbohydrate cannot be taken fro long since they are unpalatable and they also lead to low intake of sodium, ketosis — excessive breakdown of protein, involuntary dehydration and some other undesirable metabolic responses. In view of these, the Food and Nutrition Board of the National Research Council of the United States of America recommends an intake of 100gms of carbohydrate a day. Most diets are known to provide more than this figure a day.

### 3.5 Consumption of Carbohydrates

Carbohydrates are consumed by men for the supply of energy. You have learned that carbohydrate is a high energy yielding nutrient. In the tropics, where the diets of the people are still relatively poor, up to 90 percent of the

energy needs come from carbohydrate source. The diet of the rich in many countries is an energy source of about 40 percent from carbohydrate.

Thus, since carbohydrates are easy to grow; they can be easily stored at room temperature with minimum deterioration. They are a rich source of energy. This makes consumption of carbohydrate food indispensable even for the poor people. In Africa, carbohydrate is consumed a lot because it is expensive to afford proteinaceous foods.

## 2.3 Protein Sparing Action

You have learned that it is inexpensive to consume carbohydrate and that proteinaceous foods are expensive at least in Africa. Protein containing foods are even more expensive than carbohydrate foods anywhere in the world.

When there is no dietary supply of glycogen into the liver, the process of gluconeogenesis, whereby, protein is destroyed and some of its amino acids converted to glycogen for the use of liver occur. This conversion amounts to a wasteful use of protein physiologically and economically. The energy liberated from this process is less than the energy consumed. In order to spare protein from undergoing the process of gluconeogenesis, there is a need to have adequate dietary supply of carbohydrates.

### *Student Assessment Exercise 2.2*

*2.2.1 List the various sources of carbohydrate.*

*2.2.2 Give reasons for a minimum dietary intake of carbohydrate.*

## 4.0 Conclusion

This unit discusses the classes of carbohydrates, the sources, functions, requirements and consumption of carbohydrates. It also gives an important aspect of carbohydrate in preventing wasteful use of protein in the body.

## 5.0 Summary

The unit states the classes of carbohydrates as monosaccharides, disaccharides and polysaccharides and gives the examples of each of these classes.

The functions of carbohydrates are given as a source of energy, a dietary essential and as precursors of some important compounds such as nucleic acids in the body.

The sources of carbohydrate are given as cereals, roots, tubers, concentrated sweets, fruits and vegetables. The unit explains that carbohydrates are inexpensive to demand and they constitute about 90 percent of the energy source in the diets of poor people of the world.

The unit gives the need to supply dietary carbohydrate in order to spare protein of the process of gluconeogenesis that destroys proteins and converts some amino acids to glycogen so that the protein could perform more useful functions of growth and maintenance of body tissues.

## 6.0 Tutor Marked Assignment

- 6.1 What are the products of the breakdown of  
 (i) Maltose, (ii) Sucrose, (iii) Lactose  
 (iv) Starch

6.2 Discuss the various functions of carbohydrate.

Answers to the Student Assessment Exercise

2.1.1 See Section 3.2 of this unit

2.1.2 See Section 3.1 of this unit

2.2.1 There is a need for minimum dietary intake of carbohydrate to spare protein of ketosis and the process of gluconeogenesis, to prevent inadequate absorption of sodium and some other undesirable metabolic responses.

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