



YBN University, Ranchi

Carbohydrates

Learning objectives At the end of this unit, the students will be able to: Š Mention the sources of carbohydrate Š Understand the different types of sugars Š Explain the digestion, absorption and metabolism of carbohydrates Š Describe the hormone responsible for metabolism Carbohydrates provide a great part of the energy in all human diets. In the diet of poor people, especially in the tropics, up to 85% of the energy may come from this source. On the other hand, in the diet of the rich people in many countries the proportion may be as low as 40%. However, the cheapest and easily digestible fuel of humans is carbohydrate. Carbohydrates are components of body substances needed for the regulation of body processes. Heparin, which prevents blood from clotting, contains carbohydrate. Nervous tissue, connective tissue, various hormones, and enzymes also contain carbohydrate. Ribose, another carbohydrates are part of Deoxyribonucleic acid (DNA) and ribonucleic acid RNA), the substance that carry the hereditary factors in the cell. Carbohydrate is also a component of a compound in the liver that destroys toxic substances. Carbohydrates are necessary for the proper use of fats. If carbohydrate intake is low, larger than normal amounts of fats are called on to supply energy. The body is unable to handle the excessive breakdown of fat. As a result, the fat does not burn completely, and abnormal amounts of certain breakdown products accumulate in the blood, causing a condition known as ketosis. Types of carbohydrates Monosaccharides: *f* Glucose *f* Fructose *f* Mannose *f* Galactose Disaccharides: *f* Sucrose (a disaccharide present taste sugar) *f* Lactose (a disaccharide present in milk) *f* Maltose (a disaccharide present in starch) Sugar alcohol: is found in nature and also prepared commercially. Mannitol and dulcitol are alcohol derived from mannose and galactose. Both have a variety of uses in medicine and food manufacture. Honey: is a mixture of glucose and fructose. It is a balanced diet as it contains all the nutrients in sufficient amount and proper ratio. Honey has also medicinal effect. The bees first cover the beehive with antibiotics to prevent the growth and multiplications of microorganisms. If you keep honey for a long time, it will not be spoiled because of antibiotics. Glycogen: is the animal equivalent of starch present in the liver and muscle. In most foods of animal origin it is a negligible source of dietary carbohydrate. The glycogen in the liver is a reserve fuel and it serves between meals and over night. The breakdown of glycogen in the liver is facilitated by the hormone glucagons. Starch: is one form of carbohydrate that is stored in granules in the roots and seeds of plants Table. 1. Carbohydrate content of some food Food Carbohydrate Sugar 100% White Flour 80% Honey 76% Biscuit, semi-sweet 75% Jam 69% Chocolate, milk

59% White bread 50% Potatoes 21% Apple 12% Peas 11% Carrots 5.4% Milk 4.7% Digestion and absorption of carbohydrates The digestion of carbohydrates begins in the mouth by Ptyalin (amylase) produced by the salivary glands. No carbohydrate digestion takes place in the stomach. Digestion occurs mainly in the small intestine through the action of pancreatic and intestinal juices:
f Amylase f Lactase f Sucrase

Maltase Dextrin is degradation products of starch in which the glucose chains have been broken down to smaller units by partial hydrolysis. f Dextran is a carbohydrate polymer obtained from bacterial cell wall. This has no part in dietetics but is used in medicine as plasma expander. Table. 2. Summary of carbohydrate digestion Site of action Carbohydrate Enzyme End – product Mouth Small intestine Starch Starch Dextrin Maltose Sucrose Lactose Amylase in saliva (ptyalin) Amylase in pancreatic juice Enzyme in brush border of small intestine Maltase Sucrase Lactase Dextrin- maltose Glucose Dextrin- maltose glucose maltose Glucose Glucose Glucose & fructose Glucose & Galactose

In Health and with normal diet, the available carbohydrate is digested and absorbed completely in the small intestine. If an excess of unabsorbed carbohydrate arise due to a disorder of the absorption mechanisms or occasionally to excessive intake, the osmotic pressure (effects) leads to retention of fluids in the lumen and as the result there will be watery diarrhoea. This diarrhoea is known as osmotic diarrhoea. The tissues use as fuel a mixture of glucose and fatty acids. But the brain normally uses only glucose and requires around 80g daily. In starvation glucose may be provided by gluconeogenesis from the amino acids in tissues proteins, mainly from muscle proteins, but fats cannot be converted into glucose. With prolonged starvation the brain adapts and can then utilize fatty acids and ketone. The two hormones, which control the metabolisms of carbohydrates, are insulin and glucagons f Insulin is secreted by the beta cells of the islets of Langerhans and the secretion is stimulated by: – Hyperglycemias – Parasympathetic nervous activity.

Function of insulin

To facilitate glucose transport to the liver and muscle cells Š To facilitate formation of glycogen in the liver and muscle cells Š To incorporate formation of protein from the amino acids

Glucagons

is secreted by the alpha cells of the islet of Langerhans and the secretion is stimulated by Š

Hypoglycaemia Š Sympathetic nervous activity Function of glucagons To facilitate the breakdown of glycogen in the liver and muscle cells into glucose Discussion questions 1. What are carbohydrates and their importance? 2. What are the sources of carbohydrates? 3. Discuss the digestion and absorption of carbohydrates.