**Structural and functions of carbohydrates**

Student’s Name

Institutional Affiliation

Course Number and Name

Instructor’s Name

Due Date

**Structural and function of carbohydrates**

Carbohydrates are essential biomolecules that play an important role in structural support and provide energy for several biological processes. They structurally consist of carbon, hydrogen, and oxygen in the ratio 1:2:1 usually expressed as (CH2O)n. Sources of carbohydrates include grains, cereals, and fruits such as bananas. Structurally carbohydrates are grouped into monosaccharides, disaccharides, polysaccharides, and oligosaccharides. Functionally, carbohydrates provide energy for biological processes, store energy, promote digestive health, and dietary fiber, preserve muscle mass, and ensure a healthy heart. The structural diversity and functions of carbohydrates in living organisms as key biomolecules are of great importance to the biological systems in living organisms such as providing energy, storing energy, preserving muscle mass, and acting as essential components for life processes and biological functionality.

Structurally let's first discuss monosaccharides, these are the simplest and basic forms of carbohydrates that cannot be broken down into any simpler sugars, examples include glucose, galactose, and fructose. They have a chemical structure of (C6H12O6) and are an important building block of the other structures, ( Holesh et al. 2023). Chemically carbohydrates are ketones or aldehydes possessing two or more hydroxyl groups (Eldahi et al. 2019) and are grouped according to their chiral property, the number of carbons they contain, and the location of their carbonyl group.

Disaccharides; are compound sugars that are formed when two monosaccharides are linked together by a glycosidic bond that occurs between hydroxyl groups on each monosaccharide. They have a general chemical structure of (C12H22O11) and examples include maltose, sucrose, and lactose (Holesh et al. 2023). Maltose consists of two glucose units mainly from partial hydrolysis of starch. Disaccharides can be identified as reducing disaccharides, those with free carbonyl group or non-reducing ones where the carbonyl group is not available for reaction since the two monosaccharides are linked at the anomeric centers.

Polysaccharides are a long chain of monosaccharide units that are linked together by glycosidic bonds. Different polysaccharides have different structural features depending on the glycosidic linkage pattern, monosaccharide composition, molecular weight, degree of branching, charging properties, etc. (Guo et al. 2017). For example, polysaccharides can be linear also known as straight chain polysaccharides or branched chain polysaccharides in the case of branching. Polysaccharides are also classified into homopolysaccharides which are polysaccharides that contain the same types of monosaccharides such as glycogen and cellulose. The other category of heteropolysaccharide contains different types of monosaccharides such as heparin.

Carbohydrates have several functions especially in the human diet, to begin with, they are a source of energy. Glucose is the most important carbohydrate that is metabolized by the body to release energy used for physical activities like walking, dancing, breathing as well as maintaining the body temperatures and contraction and expansion of heart muscles. Blood cells, brain cells, and cell replication also require energy that is produced by the metabolism of glucose (Hermann, J. 2002). Cellular respiration releases adenosine triphosphate from the molecules of glucose that are later oxidized to release energy for cellular activities such as cell replication.

Secondly, carbohydrates are the storage of energy in the body of organisms. Excess glucose in the body is converted into glycogen by the liver and stored for later use (Pearson K, 2023). Excess glucose is harmful to the human body as it can lead to extremely high blood sugars disrupting the normal functioning of the cell hence the need to control the glucose levels, converting the glucose to glycogen as a control measure of blood sugar level is also a way of storing energy in the body for later use. In times of intense activity, glycogen is released into the bloodstream to provide extra energy needed by the muscle cells since unlike glucose, glycogen can only be utilized by muscle cells.

Thirdly, carbohydrates in the diet promote digestive health. Most carbohydrates provide dietary fibers that are not broken down by the digestive system into glucose or simpler sugars. These fibers add a bulk mass to the food that helps the food and stool move a little quicker in the digestive tract alleviating constipation (Pearson K, 2023). Dietary fibers are of different types: soluble and insoluble. Soluble fibers are those that draw water from the digestive tract as they move in the digestive tract forming gel like substance that softens the food as well as increases the bulk of the food helping in the smoothening of the bowel movement, these types of fibers are found in legumes. Insoluble fibers are found in whole grains and do not take in water. Enough of these insoluble fibers may contribute to keeping the digestive tract safe from infections.

Fourthly, carbohydrates help to preserve muscle mass. In extreme cases like starvation, the body may be forced to break down protein in the muscle to provide energy. Energy is generated from breaking down the protein in the muscle to amino acids and then to glucose that is used by the body. this process may lead to the wasting a way of the muscle mass that is primarily important for body movement activities. When glucose is stored in the form of glycogen, the body will then utilize the glycogen instead of muscle mass in the case of starvation, this helps to preserve muscle mass (Pearson K, 2023). Consuming carbohydrates ensures the body has enough glucose and glycogen stored to continually provide the brain with the energy it requires without breaking down muscle mass.

Lastly, carbohydrates influence heart health and diabetes. Consumption of excessive refined carbohydrates is certainly not good for the heart and puts one at risk of being diabetic. On the contrary consumption of dietary fiber is good for the heart in several ways. To make bile the liver utilizes cholesterol in the blood which is usually not good for the heart. As the soluble dietary fibers move in the small intestine, they bind with the bile that would be reabsorbed back and reused. To make more bile the liver continually utilizes the cholesterol in the blood (Pearson K, 2023). Additionally, the presence of fiber in the food slows down the process of digestion which ensures slow absorption of sugars and lowers blood sugar levels lowering the risk of diabetes.

In conclusion, carbohydrates are one of the most crucial nutrient sources, portraying a remarkable variety of structures and multifunctional importance. They provide energy for the body, store energy, preserve muscle mass promote digestive health as well, and ensure a healthy heart. Structurally carbohydrates are diversely classified into the least complex monosaccharides, disaccharides, and most complex polysaccharides. Carbohydrates’ structural and functional importance underscores their indispensability and profound impact on the sustenance of human life.

**References**

Guo, M. Q., Hu, X., Wang, C., & Ai, L. (2017). Polysaccharides: structure and solubility. *Solubility of polysaccharides*, *2*, 8-21. <https://books.google.co.ke/books?hl=en&lr=&id=JP2PDwAAQBAJ&oi=fnd&pg=PA7&dq=+structure+of+polysaccharides&ots=m1MSiLRIpv&sig=07Nt8uKEc69s4leEjzq7MQeRELY&redir_esc=y#v=onepage&q=structure%20of%20polysaccharides&f=false>

Hermann, J. (2002). *Carbohydrates in the Diet*. Oklahoma Cooperative Extension Service. <https://shareok.org/bitstream/handle/11244/334874/oksa_T-3117_2002-01.pdf?sequence=1>

Holesh, J. E., Aslam, S., & Martin, A. (2023). Physiology, carbohydrates. In StatPearls [Internet].

Monosaccharide. Monosaccharide - an overview | ScienceDirect Topics. (n.d.). https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/monosaccharide

Pearson, K. (2023, July 12). *What are the key functions of carbohydrates?* Healthline. https://www.healthline.com/nutrition/carbohydrate-functions#TOC\_TITLE\_HDR\_8

StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459280/