

18.3: Polysaccharides

As the weather warms up, the runners come out. Not just the casual joggers, but also the really serious runners who actually enjoy running all 26.2 miles of a marathon. Prior to these races (and a lot of shorter ones), you hear a lot about carbo-loading. This practice involves eating a lot of starch in the days prior to the race. The starch is converted to glucose, which is normally used for biochemical energy. Excess glucose is stored as glycogen in liver and muscle tissue to be used when needed. If there is a lot of glycogen available, the muscles will have more biochemical energy to draw on when needed for the long run. Meanwhile, the rest of us will sit at the sidewalk restaurant, eating our spaghetti, and enjoying watching other people work hard.

Polysaccharides

Many simple sugars can combine by repeated condensation reactions until a very large molecule is formed. A **polysaccharide** is a complex carbohydrate polymer formed from the linkage of many monosaccharide monomers. One of the best known polysaccharides is starch, the main form of energy storage in plants. Starch is a staple in most human diets. Foods such as corn, potatoes, rice, and wheat have high starch contents. Starch is made of glucose monomers and occurs in both straight-chain and branched forms. Amylose is the straight-chain form, and consists of hundreds of linked glucose molecules. The branched form of starch is called amylopectin. In the small intestine, starch is hydrolyzed to form glucose. The glucose can then be converted to biochemical energy or stored for later use.

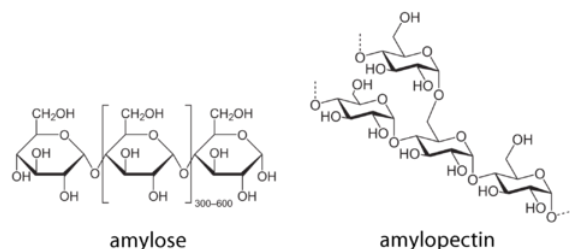


Figure 18.3.1: Amylose and amylopectin are the two most common components of naturally occurring starch. Both consist of many glucose monomers connected into a polymer. Starch serves as energy storage in plants.

Glycogen is an even more highly branched polysaccharide of glucose monomers that serves the function of energy storage in animals. Glycogen is made and stored primarily in the cells of the liver and muscles.

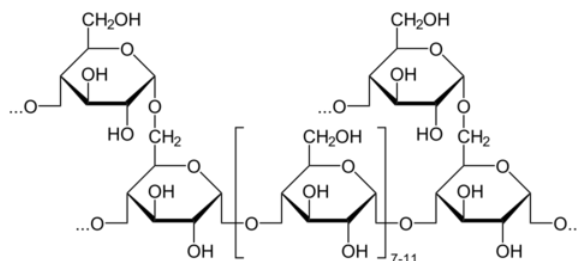


Figure 18.3.2: Glycogen is a branched polymer of glucose and serves as energy storage in animals.

Cellulose is another polymer of glucose, consisting of anywhere from hundreds to over ten thousand monomers. It is the structural component of the cell walls of green plants and is the single most common organic molecule on Earth. Roughly 33% of all plant matter is cellulose. The linkage structure in cellulose is different than that of starch, and cellulose is indigestible except by a few microorganisms that live in the digestive tracts of cattle and termites. The figure below shows a triple strand of cellulose. There is no branching and the fibers adopt a very stiff rod-like structure with numerous hydrogen bonds between the fibers adding to its strength. Cellulose is the main component of paper, cardboard, and textiles made from cotton, linen, and other plant fibers.

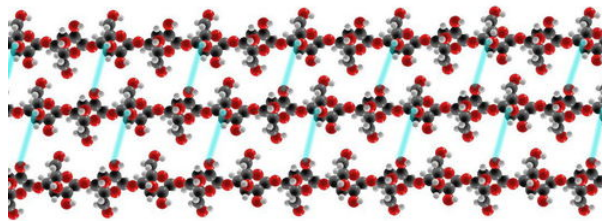


Figure 18.3.3: Cellulose is composed of very long strands of glucose monomers that are hydrogen bonded to one another. Cellulose is largely indigestible and comprises the cell walls of plants.

Summary

- A polysaccharide is a complex carbohydrate polymer formed from the linkage of many monosaccharide monomers.
- One of the best known polysaccharides is starch, the main form of energy storage in plants.
- Glycogen is an even more highly branched polysaccharide of glucose monomers that serves the function of storing energy in animals.
- Cellulose is another polymer of glucose; it is the structural component of the cell walls of green plants.

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