20.8: Simple Sugars

C=O

. Sugars are thus all aldehydes and ketones and are usually referred to as

aldoses or ketoses

. A molecule like glucose is called an alde

hex

ose since it contains

six

carbon atoms. The difference between different sugars can be very subtle. Note, for instance, that mannose and glucose differ only in the geometrical arrangement of the OH group on one carbon atom. Subtle as this difference is, molecules in a living cell can tell the difference.

> Figure 20.8.1 we have indicated the structure of the sugars in linear or chain form, but sugars usually occur in one of several ring or cyclic structures. We will only consider two of these, the α and β form of glucose. Because of the flexibility of the carbon chain, the linear form of glucose can easily adopt a conformation in which carbon atom 1 lies adjacent to the oxygen atom on carbon atom 5. When this happens, a proton can be transferred and a carbon-oxygen bond formed:

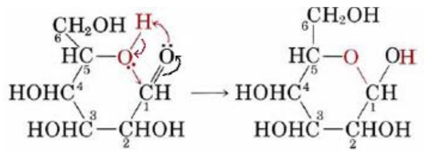
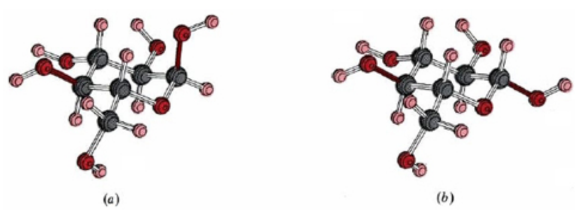


Figure 20.8.1 The linear form of some important monosaccharides: (a) ribose; (b) fructose; (c) mannose; (d) glucose.

A careful consideration of the geometry of this structure reveals that not one but two cyclic structures are possible. These are called α- and β-glucose and are shown in Figure 20.8.2. In the β form the C—O bond on carbon atom 1 (shown in dark color) is *parallel* to the C—O bond on carbon atom 4, while in the α form these two bonds are at an angle of 180° – 109.5° = 70.5°. This geometric difference may seem relatively trivial, but it turns out to be important when glucose molecules are used as building blocks to form larger entities.



> Figure 20.8.2 (a) α-glucose; (b) β-glucose. Note how the C—O bonds protruding from the left- and right-hand sides of the molecule (indicated in color) are parallel to each other in the β form but not in the α form.