

The most abundant 5 carbon sugars are D-ribose, 2-deoxy-D-ribose, L-arabinose and D-xylose.

The most abundant 6 carbon sugars are D-glucose, D-fructose, D-galactose and D-mannose.

Figs 20-1 and 20-2 show the sugars in the open chain Fischer projection and cyclic hemiacetal/hemiketal Haworth structures.

The D refers to the configuration of the penultimate (next to last) carbon atom by comparison to D-glyceraldehyde.

Note that both 5 and 6 membered hemiacetals or hemiketals are often possible.

Note that among the D-aldoses and D-ketoses, compounds corresponding to the same number of carbon atoms are diastereomers (non mirror image isomers) of each other.

There are  $2^n$  stereoisomers where  $n$  is the number of chiral centers in the molecule. There are for example 4 aldotetroses, D- and L-erythrose and D- and L-threose.

Table 20-1 indicates the occurrence of the most common sugars.

Hemiacetal or hemiketal formation generates a new chiral center as shown in Fig 9.8.

The two stereoisomers are referred to as anomers and are designated  $\alpha$  and  $\beta$ .

Fig 9.10 shows the formation of  $\alpha$  and  $\beta$  anomers of D-glucose involving reaction of the C-5 OH group with the C-1 aldehyde group to form a six membered ring.

Six membered ring structures are called pyranoses while five membered ring structures are called furanoses based on the structures of pyrane and furan.

Note the relationship between the Fischer and Haworth structures as indicated in the Fig legend.

The  $\alpha$  and  $\beta$  anomers are in equilibrium with the open chain form. The actual percentages are 64%  $\beta$  and 36%  $\alpha$  with less than 1% in the open chain.

The relative percent of the  $\alpha$  and  $\beta$  anomers indicate that the  $\beta$  anomer is more stable.

A comparison of the molecules in the chair conformation, corresponding to cyclohexane, shows that the  $\beta$  anomer should be more stable because its C-1 OH group is equatorial whereas the C-1 OH group of the  $\alpha$  anomer is axial as shown below

Fig 9.11 shows the formation of  $\alpha$  and  $\beta$  pyranose and furanose structures of D-ribose.

Consider the structures of disaccharides and polysaccharides shown in the handout.

These structures are formed by substitution of the anomeric OH group in one sugar by the O of an OH group of another sugar.

The substitution results in the formation of an acetal and/or ketal structure involving the anomeric carbon(s) as represented below

Acetals and ketals of sugars are called glycosides.

Both Haworth and chair structures of the monosaccharides are used in representing the structures of di and polysaccharides.

Sucrose is a disaccharide of  $\alpha$ -D-glucose and  $\beta$ -D-fructose joined by substitution of the C-1 OH of glucose by the O of the C-2 OH group of fructose.