5.2: General class names and Common names of monosaccharides

Learning Objectives

- Assign and interpret class names of monosaccharides.
- Assign D/L stereodescriptors to the common names and define epimers.
- Draw structure from the name and vice versa for important monosaccharides, including D-ribose, D-glucose, D-mannose, and D-galactose.

General class names of monosaccharides

Monosaccharides are either polyhydroxy aldehydes that take *aldo* as prefixes or polyhydroxy ketones that take *keto* as prefixes in their general name. The general formula of monosaccharides is $C_nH_{2\,n}O_n$ where n can be 3, 4, 5, 6, 7, or 8 representing triose, tetrose, pentose, hexose, heptose, or octose, respectively, in the general name. For example, D-glucose belongs to aldohexose, where the aldo- prefix tells it is an aldehyde, -hex- in the middle of the name tells it has six C's, and -ose suffix denotes it is a carbohydrate. D-fructose belongs to ketohexose, i.e., it is a monosaccharide with a ketone group and six C's. D-glyceraldehyde is an aldotriose, i.e., a monosaccharide with an aldehyde group and three C's.

Common names of monosaccharides

Common names are specific for each monosaccharide. All C's in a monosaccharide are chiral centers except the two terminal C's and the C of ketone group if it is a ketose. The absolute configuration of the **penultimate** C, i.e., the second-last C, is explicitly expressed by D- or L-stereochemical descriptors and the absolute configuration of all other chiral centers is implicit in the common name of the monosaccharide. There is one set of common names for all D-isomers, and their mirror images (enantiomers) have the same common name with D- replaced with L-. For example, D-glyceraldehyde and L-glyceraldehyde, D-glucose, and L-glucose are enantiomer pairs shown in Figure 5.2.1.

D/L Stereochemical descriptors

If the $-OH$ group on the second-last carbon (penultimate C or the second C from the bottom end) in Fisher projection of a monosaccharide is on the right side, it is assigned D- and if it is on the left side, it is assigned L-configuration. Monosaccharides that are enantiomer pairs have the same common name, but D- is replaced with L- or vice versa. For example, D-glyceraldehyde and L-glyceraldehyde, D-glucose and L-glucose enantiomer pairs are shown in Figure 5.2.1. with the penultimate C defining D- or L-configuration shown in red color.

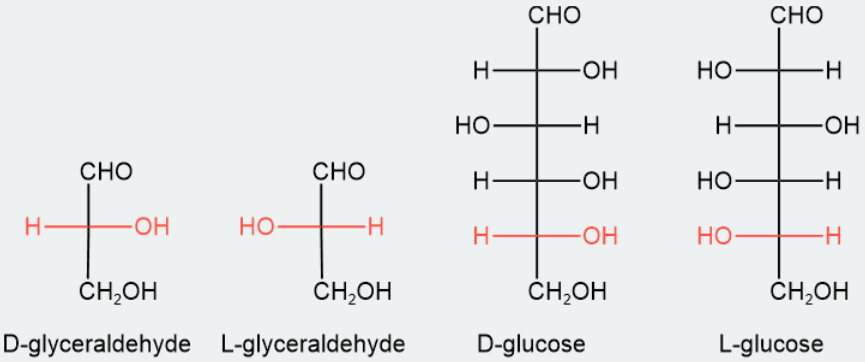

Figure 5.2.1: Assigning D- or L-configuration based on orientation of $(-OH$ on penultimate C in Fisher projection. (Copyright; Public domain)

D-configuration of monosaccharides is commonly found in nature. The D/L stereodescriptors do not indicate the rotation of the plane polarized light, i.e., the enantiomer's dextro/levo rotatory nature. However, if one enantiomer is dextro (d-), the other is levo (l-) to the same degree, and vice versa.

The structures as Fisher projections and common names of D-aldoses are shown in Figure 5.2.2. and those of D-ketoses are shown in Figure 5.2.3. These are the most common monosaccharides found in nature.

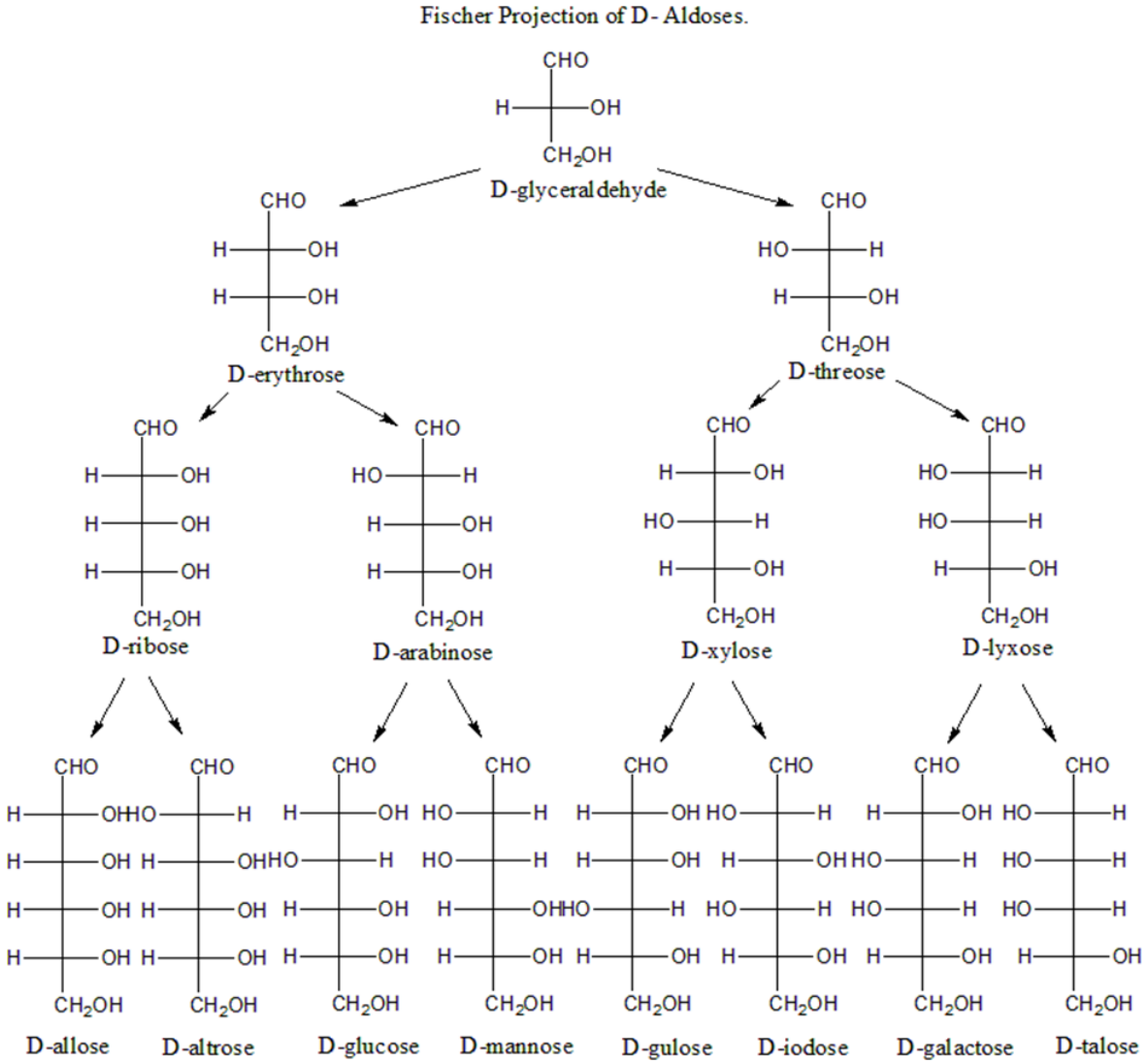

Figure 5.2.2: Fisher projections and common names of D-aldoses. (Copyright; Dineshts, Public domain, via Wikimedia Commons)

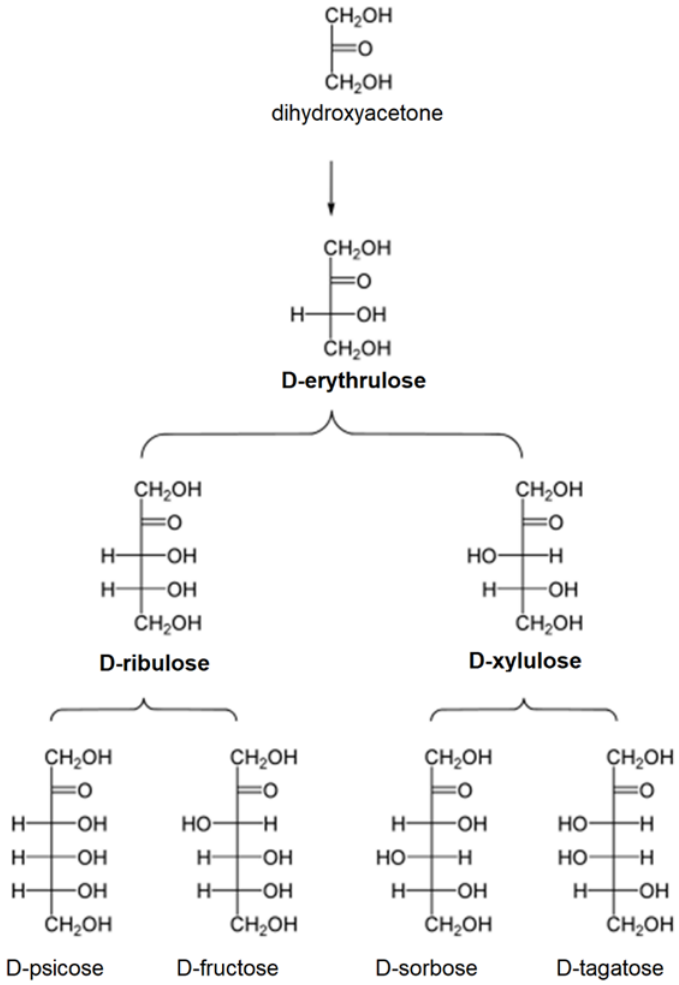

Figure 5.2.3: Fisher projections and common names of D-ketoses. (Copyright;modified from: Yikrazuul, Public domain, via Wikimedia Commons)

Some important monosaccharides

D-Glucose is the most abundant monosaccharide in nature. Plants produce it in a photosynthesis process. D-Galactose and D-mannose are two important diastereomers of D-glucose that differ from D-glucose in the configuration of only one chiral center.

Epimers

Epimers are diastereomers that differ in absolute configuration of only one chiral center. For example, D-galactose configuration is different from D-glucose only at C#4, i.e., D-galactose is a C4-epimer of D-glucose. Similarly, D-mannose is C2-epimer of D-glucose.

D-Fructose is another important monosaccharide that differs at C#1 and C#2 from glucose. That is, the C=O is an aldehyde group at C#1 in D-glucose, but it is a ketone at C#2 in D-fructose. Fisher projections of D-glucose, D-galactose, D-mannose, and D-fructose are shown in Figure 5.2.4. with the differences from D-glucose highlighted by red-color fonts. D-ribose is another important monosaccharide present in RNA.

Drawing structures of important monosaccharides

D-ribose is aldopentose, i.e., an aldehyde with five C′s. All chiral C′s have −OH groups oriented towards the right in the Fisher projection. D-allose is aldohexose with the same structural features as D-ribose, i.e., all chiral C′s have −OH groups oriented towards the right in the Fisher projection. D-glucose is C3 epimer of D-allose. The other three important monosaccharides can be drawn by relating them to D-glucose, i.e., D-galactose is a C4 epimer, D-mannose is a C2 epimer of D-glucose, and D-fructose has a ketone group at C2 in the place of aldehyde group of D-glucose at C1.

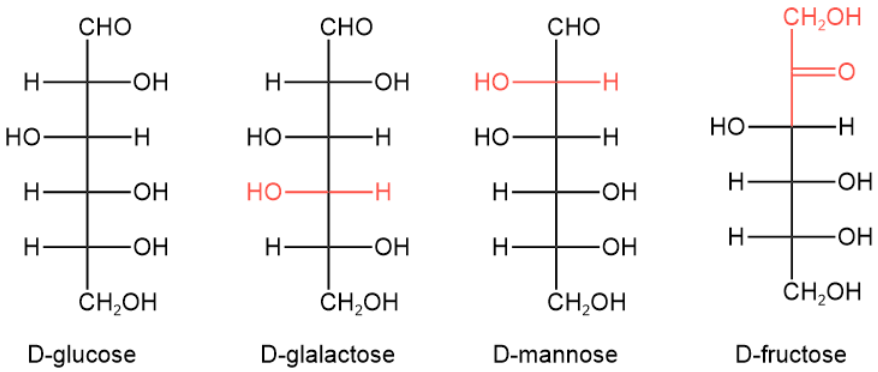

Figure 5.2.4: Fisher projections of four important monosaccharides with their differences from D-glucose highlighted by red-color fonts. (Copyright; Public domain)
