CHAPTER 3

Carbohydrates in Food: An Introduction

INTRODUCTION

Carbohydrates are organic compounds containing carbon, hydrogen, and oxygen, and they may be simple or complex molecules. Historically, the term “carbohydrate” has been used to classify all compounds with the general formula $\text{C}_n(\text{H}_2\text{O})_n$ as the hydrates of carbon. Important food carbohydrates include simple sugars, dextrins, starches, celluloses, hemicelluloses, pectins, and gums. They are an important source of energy or fiber in the diet, and they also are important constituents of foods because of their functional properties. Carbohydrates may be used as sweeteners, thickeners, stabilizers, gelling agents, and fat replacers. The simplest carbohydrates are known as monosaccharides or sugars, and they have the general formula $\text{C}_n\text{H}_{2n}\text{O}_n$. The most common ones contain six carbon atoms. Disaccharides contain two sugar units, trisaccharides contain three, oligosaccharides contain several units, and polysaccharides are complex polymers containing as many as several thousand units linked together to form a molecule.

MONOSACCHARIDES

Monosaccharides are simple carbohydrates containing between three and eight carbon atoms, but only those with five or six carbon atoms are common. Two of the most important ones in foods are the six-carbon sugars glucose and fructose. These have the general formula $\text{C}_6\text{H}_{12}\text{O}_6$.

Examples of Monosaccharides

Glucose. Glucose is known as an aldose sugar because it contains an aldehyde group (CHO) located on the first carbon atom of the chain. It is conventional

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1 For use with subsequent carbohydrate food chapters.
to number the carbon atoms along the chain so that the carbon atom with the highest number is farthest away from the aldehyde (or functional) group. The aldehyde group therefore is located on carbon one in glucose (and in all other aldose sugars). The numbering of the carbon atoms in glucose is shown above.

Two isomers of glucose exist, which are mirror images of each other: D-glucose and L-glucose. D-Glucose is the isomer that occurs naturally.

In fact, there are two series of aldose sugars, known as the D-series and the L-series, each formed by adding CHOH groups to build the carbon chain, starting from the smallest aldose sugar, which is D- or L-glyceraldehyde.

Each H–C–OH group within the chain is asymmetrical (since the H and OH groups are different). The highest-numbered asymmetric carbon atom of each D-series sugar has the same configuration as D-glyceraldehyde, rather than its L-isomer. In glucose, the highest-numbered asymmetric carbon atom is carbon-5. This is termed the reference carbon atom, because its configuration determines whether the sugar belongs to the D series or to the L series. The hydroxyl group attached to it is called the reference hydroxyl group. This group is always on the right side in a D-series sugar.

**Figure 3.1** The main isomers of D-glucose (Fischer projections).