CHAPTER 4

Starches in Food

INTRODUCTION

Starch is a plant polysaccharide stored in roots and seeds of plants and is in the endosperm of a grain kernel. It provides humans with energy (4 cal per gram) and is hydrolyzed to glucose, supplying the glucose that is necessary for brain and central nervous system functioning.

Starch grains, or granules, contain long-chain glucose polymers and are insoluble in water. Unlike the small molecules of salt and sugar, the larger starch polymers do not form a true solution. Instead, starch granules form a temporary suspension when stirred in water. As uncooked granules, each may swell slightly as it absorbs water. However, once starch is cooked, the swelling is irreversible and the starch leaches out. This characteristic of starch granules enables starch to be used as a thickener.

Overall, the characteristics of a finished starch food product are determined by several factors: the source of starch, concentration of starch used in a formulation, the temperature of heating, and other components used with the starch, such as acid and sugar. There are many types of starch and modified starches. They thicken, prevent curdling, stabilize cooked salad dressings, and more.

Intermediate, shorter, chain products from starch breakdown, known as dextrins, may be used to simulate fat in salad dressings and frozen desserts. For example, wheat, potato, and tapioca maltodextrins may be used as fat replacers. They provide the viscosity and mouthfeel of fat in a food product, yet with reduced calories compared to fat.

STARCH SOURCES

Starch sources are numerous, with common ones derived from cereal grains such as wheat, corn, or rice. Wheat yields a cloudy, thick mixture, while cornstarch produces more clear mixtures such as gravies or sauces. Vegetables, roots and
Carbohydrates

Tubers, including the root of cassava, and potatoes frequently are used in the preparation of gluten-free foods, where wheat allergies do not permit the use of wheat as a thickener. Specialty starches are available commercially and some may be available to the consumer, purchased through specialty food stores.

Another source of starch is legumes such as soybeans or garbanzo beans. As well, sago is a powdery starch obtained from the stems and trunks of the sago palm in tropical Asia. It may be used a food thickener and fabric stiffener. Fruits also may be sources of starch. An example is the banana.

Thus, starch may come from a variety of sources. Depending on the source, starch also may have different crystalline structures.

Starch Structure and Composition

The starch granules from various grains differ in size, ranging from 2 to 150 microns. Their shape may be round or polygonal, as seen in the photomicrographs of corn, wheat, and waxy maize in Figures 4.1–4.3.

Starch is made up of two molecules, amylose and amylopectin, whose parts are connected by glycosidic linkages (see Ch. 3). Amylose molecules typically make up approximately one-quarter of starch. Amylose is a long linear chain composed of thousands of glucose units with attachment of the carbon 1 and carbon 4 of glucose units, and therefore contains α-1,4 glycosidic linkages. It forms a 3-dimensional network when molecules associate upon cooling, and is responsible for the gelation of cooked, cooled starch pastes.

Figure 4.1 SEM of normal cornstarch granules (1000X) (Source: BeMiller, J.N., Purdue University-Whistler Center for Carbohydrate Research).