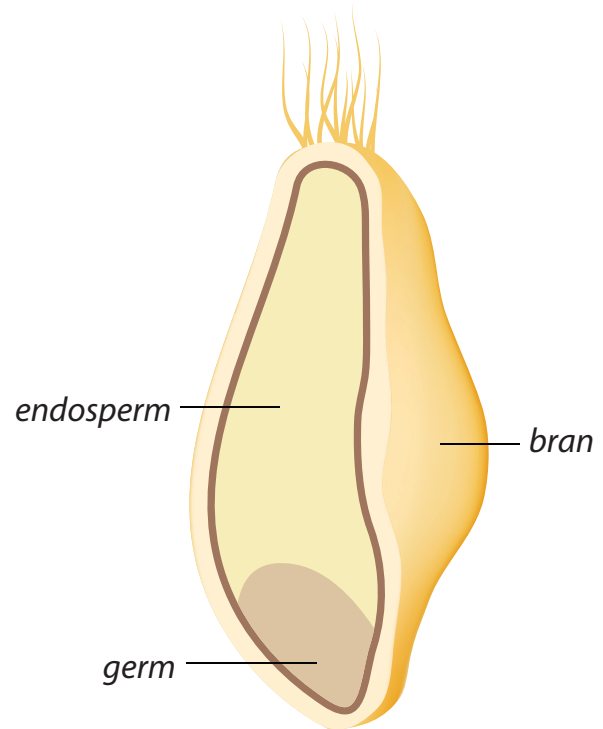


Chapter 7: Grains

FLOUR POWER

Did you know that all whole grains are composed of three parts?

Grains are made up of the **bran**, **endosperm**, and **germ**. Each serves a different purpose for the grain and for human health. A **whole grain** contains all of the parts and nutrients of the grain seed. This includes the germ, bran, and endosperm. The bran is the outer layer of the kernel. It contains antioxidants, B vitamins, and fiber. The germ is the embryo, which can be used to sprout a new plant. It contains B vitamins, some protein, minerals, and healthy fats. The endosperm is the largest inner portion of the kernel, and provides the germ's food supply. **Refined grains** have been milled, which removes the bran and germ. Milling also removes the **fiber**, iron, and many B vitamins from the grain. Carbohydrates that cannot be digested are called fiber. Fiber contains cellulose, which our bodies do not have the enzyme to digest. Fiber helps support a healthy digestive system. Most refined grains are enriched, which means that certain B vitamins and iron are added back after processing. You will learn more about the parts of grains in *Food Explorations Lab I* of this chapter.



All grains contain starch, because it is located in the endosperm. Starch is often called a **complex carbohydrate**. Unlike **simple carbohydrates**, complex carbohydrates are made of many units of carbohydrate that have been linked together to form a complex chain. Simple carbohydrates only have one to three units of carbohydrate in their chain.

Amylose is a type of starch that is made of a long chain-like molecule. In our mouth, chemical digestion begins when amylose is broken down into simple carbohydrates by an enzyme found in our saliva called **amylase**. The largest source of starch is corn, but it can also be found in wheat, potatoes, and rice. Although corn and potatoes aren't necessarily grains, we identify them as starchy vegetables because they contain a large amount of starch. You will learn more about starch digestion in *Food Explorations Lab III* of this chapter.

Various types of protein can also be found in the grain seed. Among those proteins is **gluten**. Gluten can easily be found in wheat, barley, and rye. When water is added to flour and the mixture is properly stirred or kneaded, flour proteins bond to form gluten. Gluten is necessary for the formation of dough and batter. As gluten develops, the mixture becomes elastic and strong, providing texture and chewiness to baked foods. Adding salt can strengthen the gluten development, but adding sugar, fat, or acids can weaken its formation. Gluten formation can be a very tedious process! You will learn more about gluten in *Food Explorations Lab II* of this chapter.

Some people are allergic to gluten. In severe cases it is called **Celiac disease**. Individuals who eat foods containing gluten will experience inflammation in the small intestine. The inflammation can cause damage to the small intestine and prevent absorption of some



In the context of grains, simple carbohydrates are typically made from refined grains (top). Complex carbohydrates are typically made from whole grains (bottom).

nutrients. It is important that people with Celiac disease avoid gluten in their diets. Gluten-free foods are now available to help people who cannot tolerate the protein. Grains and starches such as rice, corn, and buckwheat do not contain gluten and can be included in a gluten-free diet. No matter the gluten content, all grains are an important part of everyone's diet. Let's explore the structure and function of grains!



Think About It

Food Explorations Lab I

1. The parts of a grain are _____, _____, and _____.
2. The _____ provides the germ's food supply.
3. Refined grains have the _____ and the _____ parts removed during milling.

Food Explorations Lab II

1. Proteins found in grains combine with water to form _____.
2. As _____ forms, dough becomes _____ and strong.
3. A person allergic to gluten may have _____.

Food Explorations Lab III

1. The starch in a grain is in the _____.
2. _____ carbohydrates have one to three units of carbohydrates, while _____ have many.
3. The starch _____ is broken down by the enzyme _____ found in our saliva.