

## POPCORN

By Lynn K. Sibley

You're hungry and the cupboard is bare. How about some popcorn? You get out the popper, pour in the oil, and drop in a test kernel. The oil sizzles... suddenly the kernel bursts into white fluff and jumps out of the pan. The oil is now at the right temperature. You pour in more corn, just covering the bottom, and wait. A slow tapping builds into a crescendo of happy popping. The kernels beat against the lid, lifting it slightly, and some vapor puffs out. Oh, what an aroma! You open the popper and toss a few of the fluffy mounds into your mouth. But wait a minute! Did you ever wonder why popcorn pops? Just what *is* that white stuff? And what was the vapor that escaped from the popper? There is a lot of interesting chemistry in a kernel of popcorn. Fill up your bowl and read on.

### ***An American Heritage***

Popcorn, a New World grain, has been an American favorite for centuries. Columbus found the natives in the West Indies not only eating popcorn, but wearing it as jewelry. The English colonists were introduced to popcorn at the first Thanksgiving feast when an Iroquois Indian brought a deerskin bag of popped corn as a gift. Quick to put this unusual food to use, the colonial families ate popcorn with cream, sugar, and fruit for breakfast—the first “puffed” cereal.

Popcorn took to the streets in 1885 when Charles Cretors invented the steam-powered popping machine. In 1893 our first “junk food” was introduced at the Chicago’s World Fair: a combination of popcorn, peanuts, and molasses called Cracker Jack. Popcorn became an irresistible attraction at baseball games and circuses. Then, a new fad called “movies” took popcorn inside, and sales exploded.

### ***Steam Power***

Popcorn, a cereal grain like wheat or oats, is about  $\frac{3}{4}$  carbohydrate (starch), with smaller amounts of protein, fat, minerals, and water. The water plays a critical role in the popping process. When heated, the moisture inside the kernel turns into steam. As the pressure increases, the starch expands and the kernel explodes. We like popped corn that is large and tender. This requires just the right amount of water in each kernel. Farmers harvest popcorn when the moisture content is 16% to 19% by mass. To ensure maximum popping expansion, the corn is

then carefully cured (dried) until it reaches 13% to 14% moisture.

Like other cereals, popcorn kernels consist of three main parts: the pericarp (the hull or outer covering), the germ (the part that sprouts), and the endosperm (the starch that expands.) Popcorn acts the way it does because of the special construction of the pericarp and the microscopic structure of the endosperm.

Popcorn has an extra strong pericarp. This tough, protective layer acts like a seal, holding in the steam until the pressure builds up high enough and the kernel explodes. If the pericarp has been cut or cracked during processing, the steam will be vented and the kernel will not pop properly. You may have heard of “hull-less” popcorn. Despite the name, all popcorn has hulls- it could not pop without them. In the so-called hull-less varieties, the pericarp simply separates itself better from the puffed endosperm and has less chance of sticking in your teeth.

Corn has two kinds of endosperm, *translucent* and *opaque*, which are named according to their appearance. The expansion, or popping, takes place in the tightly packed translucent endosperm. Therefore, the proportion of translucent and opaque endosperm in a kernel accounts for a corn’s “poppability.” Popcorn contains mostly translucent endosperm, which is better at popping.

When you first pop popcorn, the pressure inside and outside the kernel is the same. As the kernel heats (in oil which is typically 230°F) the moisture turns to steam, and the internal pressure rises. When the temperature inside the kernel climbs above 100°C, you might expect that all the water would turn to steam. In fact, only a small amount vaporizes because the tough pericarp acts like a pressure cooker. The boiling point of water is 100°C at normal atmospheric pressure, but is higher at greater pressures.

The high-pressure steam penetrates the starch granules and transforms them into hot, gelatinized globules. Finally at about 175°C, when the pressure inside the kernel is about 9 atmospheres (135 lb per sq in.,) the pericarp ruptures.

The steam and superheated water (water above 100°C,) now surrounded by normal-pressure air, become the driving force that expands the kernel. The gelatinized starch granules do not explode, but expand into thin, jellylike bubbles. Neighboring bubbles fuse together and solidify, forming a three-dimensional network much like a sink full of

soapsuds. This is the white fluffy solid we eat. The moisture content of the kernel is now about 1-2%, and the popcorn is transformed into a tender, fluffy morsel.

Popcorn comes in two natural colors, white and yellow, which are located in the endosperm.

Artificial colors color only the pericarp, which is blown off during expansion. In the past, white popcorn was favored by home poppers as the most tender. Today, 90% of all popcorn is yellow- its larger kernels are more flavorful and it has an appealing already-buttered look.

### ***Pop Art***

You can pop your corn several ways. One is the dry method. Used first by the Indians who popped corn in ceramic pots over open fires, this method has been revived in modern hot-air poppers. More common is the wet method, using oil. Although any vegetable oil will do, pop experts prefer coconut oil. The newest method is popping by microwave. The popcorn is sold in a special bag, complete with seasoning. When placed in a high-wattage microwave oven, the bag expands as the popcorn pops.

To achieve maximum popability and expansion, you must treat your popcorn with care. To maintain the ideal moisture content of 13-14.5%, store popcorn in tightly-covered containers at a cool temperature. Unpopped corn can lose as much as 3% moisture in five to six days if it is not sealed tightly or if it is too hot. To restore dry popcorn: fill a quart jar  $\frac{3}{4}$  full of popcorn, add a tablespoon of water; cover tightly, and shake thoroughly. In about four days, your popcorn will be ready to give you its best- it will be tender, fluffy, and, oh, so delicious.

### ***A-Maize-ing Facts***

-Americans eat 9.9 billion qt of popped popcorn annually-that's 42 qt per man, woman, and child (except in Minneapolis-St. Paul, where the champion popcorn eaters consume twice that amount.)

-70% of the popcorn is eaten at home. Most of the rest is munched at theaters, stadiums, and schools.

-Real butter topping disappeared from theaters years ago. That golden liquid squirted on your popcorn is typically partially hydrogenated soybean oil, artificial butter flavor, TBHQ (preservative,) and artificial color.

-Until a few years ago, the volume of popped corn was about 25 times as great as the volume of the

unpopped kernels. Today's hybrid popcorns expand even more.

-The word *corn* has been used for more than one kind of grain. The biblical "corn" was probably barley. The English "Corn Laws" of 1436 referred to wheat. In Scotland and Ireland, "corn" means oats. In short, the predominant grain crop grown in an area was usually called "corn." The crop called corn in the US is more properly called maize.

### ***Just For Fun***

Today's "popcorn boutiques" offer as many as 50 flavors, including root beer, piña colada, and chocolate. Here's how you can make some of these treats:

#### ***Pizza Popcorn***

Pop about 3 qt of popcorn. In a large bowl, mix the popcorn with  $\frac{1}{2}$  cup of melted butter or margarine. Sprinkle on 3 tablespoons of dry spaghetti sauce mix, 3 tablespoons of oregano, and some parmesan cheese. Mix the ingredients gently- and enjoy.

#### ***Fruity Popcorn***

Place about 3 qt of popped corn in a large, buttered bowl. In a saucepan, combine  $\frac{1}{2}$  cup of sugar and  $1\frac{1}{2}$  cups of light corn syrup. Heat to a boil while stirring constantly. When it bubbles, remove from heat and stir in a 3-oz package of fruit-flavored gelatin mix- any flavor you like. When the gelatin has dissolved, quickly dribble the mixture over the popcorn. Cool the popcorn on a greased cookie sheet; then break into bite-sized pieces.

#### ***Pops Up Years Later***

Fossil corn pollen, 80,000 years old, has been found in excavations under Mexico City. It is very similar to modern corn. Kernels of popcorn discovered in Bat Cave, NM, (radiocarbon dated at 2000 BC) still pop! Pre-Incan pottery poppers date back 1500 years. According to Paul C. Mangelsdorf, Harvard popcorn researcher, "all races of wild corn were popcorns, their kernels small and flinty in texture, almost impossible to chew, and difficult to grind. Their real usefulness was discovered when kernels accidentally exposed to the heat of glowing coals exploded to become tender, tasty morsels with the nutritional value of whole grain bread. The current popularity of popcorn in the home and at the cinema represents a counterpart of corn's first use by the American Indians."