



# Heartland Science

Ohio's Legacy of Discovery & Innovation



## Agriculture & Food

From Aquaculture to Hot Dogs

### Baking Up A Revolution: Charles and Maximillian Fleischmann

The Fleischmann brothers invented a process for making cubes of compressed yeast in 1868 in Cincinnati. Their original Compressed Yeast Cake was the first commercially produced yeast. It marked the start of modern home and commercial baking in the United States. Commercial yeast consists of living microorganisms in suspended animation. When mixed with water and flour, they start growing and release carbon dioxide gas that makes dough rise. Yeast also produces chemical compounds that make bread flavorful. Bread without yeast would be flat, hard, and almost tasteless. The new Fleischmann's Yeast made:



- Bread and baked goods with a better flavor and texture than traditional home-brewed "starters." Those were wild yeast cultures that people grew themselves.
- Home baking simpler and more convenient, freeing homemakers from the care-and-feeding of homemade starters.
- Commercial baked products more uniform in quality.
- A hit with consumers, and still is America's top-selling yeast.

During World War II Fleischmann's research laboratories took convenience one-step further, developing Active Dry Yeast™, to ensure that American troops could enjoy home-baked bread. The new product needed no refrigeration, and the yeast went to work quickly right after addition of warm water. In 1984, yeast got another Fleischmann tweak with development of RapidRise™ Yeast, which makes dough rise up to 50% faster than regular active dry yeast. In 1993, Fleischmann's introduced Bread Machine Yeast, specially formulated for those popular machines.



### A Revolution in Baking

Cardboard bread. That's how some people describe bread made without yeast. "Unleavened" bread is flat, dry, and crispy as a cracker. Try matsah, the bread traditionally eaten during the Jewish Passover holiday, to see the world of difference yeast makes. Yeast gives bread, hot dog rolls, pizza crust, cinnamon buns, and other baked goods a lighter texture and a wonderful flavor and aroma. Bakers just open the cupboard and reach for a little packet of dry yeast, add it to the mixing bowl, and the microorganisms come to life and start working almost instantly. Baking good bread wasn't always so easy.



Baking good bread wasn't always so easy. Even after the Civil War, American home and commercial bakers had to grow their own yeast and work hard to keep it alive. Before the Fleischmann Brothers invented commercial yeast, people baked bread like the Egyptians 4,000 years earlier. Each family, or bakery, kept a crock of sourdough or other "starter" or "leavener." They were living cultures of yeast growing slowly in a flour-and- water dough saved from the last batch of bread.

People hoarded and fought over their starters. Pioneer families carried a crock of starter West in covered wagons. They had to tend their microorganisms, and the care and feeding of starter took some work. The crock of starter needed regular feedings of flour and water. On cold nights, someone slept with the crock to keep the yeast warm and alive. If the starter died, you had to borrow some from a friend, or leave a container of flour and water in the open air to catch wild yeast floating by. Before baking day, the starter might get a little extra flour and sugar to make the yeast grow faster. Then a little starter went into the new batch of bread, and a little stayed in the crock for next baking day. It took a long time for the starter to work, and make the bread rise. Baking bread took an entire day.



When Charles and Maximilian Fleischmann arrived in Cincinnati in the 1860s, they discovered another problem with home-kept yeast: It often didn't work very well. American bread seemed to have a dense, heavy texture and unpleasant taste, compared to the light flavorful loaves of "Vienna" bread that the brothers made at home. The immigrants left their home, just outside Budapest, Hungary, for a new life in America. They realized that yeasts were the problem, and saw the need for a uniform product that would perform reliably every time without the fuss of tending microbes. With money from businessman James W. Gaff in 1868, they invented a way to make large amounts of baking yeast, and patented the process.

The process involved growing yeast in tanks of a nutrient solution called "wort." It contained plenty of sugar for the microbes to feed on and multiply. As the number of yeast cells increased, the wort became thick and creamy. Workers then separated the yeast from the wort, and compressed it into cube-like "cakes" that were packaged for sale.

Fleischmann's yeast became a national commercial success after Charles and Max set up a bakery concession at the Philadelphia's Centennial Exposition, a World's Fair held in 1876. About 10 million people visited the fair. Many sampled fresh-baked bread from the Fleischmann's "Vienna Bakery," and learned that they could make the same loaves at home with the Brothers' Compressed Yeast Cake.

### **The Science Behind the Invention** **"The Oldest Organism Cultivated by Humans"**

People have been growing yeast in homemade "starters" to make bread for more than 4,000 years. However, it wasn't until 1857 that the French microbiologist Louis Pasteur discovered that yeast is alive, a microorganism visible only through a microscope. Charles and Max Fleischmann invented a way of growing those microbes, harvesting them, and putting them into suspended animation in little cubes. They also successfully sold the cubes to consumers, making Fleischmann's yeast the most widely used in America.

Yeasts are single-celled organisms called fungi that exist naturally in the soil and air. Scientists have identified more than 700 different species of yeast. *Saccharomyces*

*cerevisiae* is the yeast that the Fleischmann Brothers turned into a commercial product, and the most common kind used in baking. Yeasts also are used to make beer, wine, and other alcoholic beverages. Not all serve humanity. Some cause infections in humans, and others make food spoil.

Yeasts play key roles in fermentation, a process in which complex molecules are broken down into simpler ones. Fermentation is at the heart of a huge industry that produces not just bread, beer, and wine but millions of gallons of ethanol for "gasohol," antibiotics, vitamins, and chemicals used to make many other products. That's because different kinds of microbes can break down, or metabolize, different substances. In doing so, they produce different products that can be harvested and used.



In bread making, *S. cerevisiae* breaks down flour's big starch molecules into sugars. Yeast uses the sugars as its own food to grow, releasing carbon dioxide gas. The tiny bubbles of CO<sub>2</sub> actually inflate bread dough, creating gas pockets that give bread a lighter texture. Those little holes in a slice of bread are gas pockets. Yeast doesn't form much alcohol in the stages of fermentation that occur in bread making. Yeast does a lot more. For instance, it helps produce a host of molecules that give bread a wonderful flavor and aroma. Yeast also helps change the two main protein molecules in wheat flour - gliadin and glutenin - into gluten. Gluten is an elastic substance, consisting of long, thread-like chains, that gives bread a nice chewy texture. Gluten chains also help trap those carbon dioxide bubbles that give baked goods a light, airy texture.

## Back to the Future

### Humble Yeast: A Champion of the Genetics Revolution

When Charles and Max Fleischmann were alive, yeast was a tool for making bread rise, brewing beer, and making wine. Never did they dream that *Saccharomyces cerevisiae*, which they packaged for home and commercial bakers, would become a key tool in genetics research and biotechnology. Scientists use yeast in genetics research because it is easy to grow, simple (with only 6,000 genes compared to perhaps 130,000 in humans) to study, and has many genes similar or identical to those in humans. Evolution led to the appearance of "one-size-fits-all" genes, which do the same job in a wide variety of organisms. About 70% yeast genes are very similar to genes found in humans. Knowledge about how such a gene works in yeast, thus sheds light on how the corresponding gene works in humans.

Although yeast is single-celled, it is a very advanced organism. Like humans, it belongs to a group called "eukaryotes." All eukaryotes share similarities in their cell anatomy, including a distinct nucleus and compartmental structures for carrying out specialized processes. In 1996, scientists deciphered the *S. cerevisiae* genome, the genetic blueprint for yeast used in baking and brewing. They determined the order of all 12,057,500 chemical subunits contained in the yeast's nuclear DNA. Yeast had the largest genome of any organism - or full set of genetic instructions - to decipher at that point. It gave scientists some of their first comprehensive knowledge about how all the genes in a eukaryotic cell function as an integrated system.

