

THE BIZARRE SHARED BIOLOGY OF

Salt-Rising Bread and Gas Gangrene

More than a century ago, pioneers of the American frontier who found yeast hard to come by noticed that, under certain conditions, an unleavened starter of milk and flour would sometimes ferment and froth on its own if it was kept warm—roughly body temperature or hotter. Dough mixed with the starter rose and baked well into a dense white bread.

Not knowing how this worked, the pioneers of Appalachia took to calling it salt-rising bread (a puzzling name because salt is not a necessary ingredient; one theory is that frontier women stored their starters in salt barrels, which warmed in the sun). Companies started selling starter mixes for salt-rising bread and recommended adding the mix to boiling milk before letting it cool to fermentation temperature. In 1898, the Bureau of Chemistry in the U.S. Department of Agriculture published a bulletin that attributed the rising action to “enzymes naturally present in the flour.” This explanation never seemed satisfactory, however, because it couldn’t explain why the dough sometimes rose aggressively and other times failed to rise at all, nor why the bread tended to smell a bit funny, like strong cheese or unwashed feet.

By 1911, the biologist Henry Kohman had worked out the true cause: the doughs “contained no yeast cells but literally swarmed with bacteria,” as a colleague of his later recounted. Through a series of diligent experiments, Kohman isolated the gas that was causing the bread to rise and found that most of it was not carbon dioxide, as produced by yeast and lactic acid bacteria, but hydrogen. He theorized that spores of an anaerobic bacteria were somehow getting into the mix and then germinating, reproducing, and digesting sugars into hydrogen as they grew in the warm starter.

Kohman was proved right a few years later by a USDA biologist, Stewart Koser, who conducted what has been called perhaps the most macabre experiment in culinary history. Examining the frothy starter under the microscope, he observed that it contained up to 100 million microbes per gram. Almost all the organisms appeared to be *Clostridium perfringens* bacteria (then known as *Bacillus welchii*)—a species that causes the deadly diseases pigbel and gas gangrene (see page 203). The intrepid investigator obtained a culture of *C. perfringens* that had been isolated from a soldier’s festering wound and used it to make salt-rising bread.

In the years since, biologists have used more advanced methods to try to understand why salt-rising bread seems to be safe to eat—at least, medical authorities have yet to report anyone being sickened by it. Researchers point to a number of likely reasons. Many strains of *C. perfringens* exist in the environment, and only a few of them manufacture the toxin that causes illness (typically cramping and diarrhea in otherwise healthy people). Temperatures higher than 80 °C / 176 °F inactivate the toxin—and the bacteria start dying off at temperatures even lower than that—so the heat of baking largely neutralizes the pathogen. Although a few microbes may survive baking, the infective dose for *C. perfringens* is relatively high, with about 100,000 bacteria per gram of food typically needed to cause infection.

The flavor of salt-rising bread is hard to describe. If you would like to experience it for yourself, you can use our recipe on [page 4-314](#) to make a batch. Just take care to treat the starter and uncooked dough with the respect they deserve. If you catch the salt-rising bread bug, you want it to be in a *good* way.

The same *Clostridium* bacteria that are used to make salt-rising bread can be a source of disease in both humans and their livestock. Fortunately, a veterinary vaccine is available.

