



MICROBIAL BAKERS: THE INVISIBLE HEROES OF BAKING INDUSTRY

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The aroma of freshly baked bread wafting through the bakery is one of our life's simple pleasures, right. And behind this process, is the invisible kitchen crew: the microbes.

Microbes play a very crucial role in bread baking. These tiny organisms, especially yeasts and bacteria carry out fermentation, a process that causes dough to rise, develop rich flavors and makes it easier to digest. While many people associate microbes with illness or decay, in the baking industry, they are the invisible heroes of every loaf.

History: The Evolution of Microbial Influence In Baking



Microbes have been crucial in the baking industry for over thousands of years. Ancient Egyptians were the first to discover fermentation by leaving dough out, which caused it to rise naturally and what they weren't aware was that the wild yeasts and bacteria from the environment had entered the dough and started fermenting the sugars. By the time of the Romans, sourdough was widely used, and baker's guilds were established.

In the 19th century, Louis Pasteur discovered that fermentation was caused by microbes, paving the way for the commercial production of "baker's yeast". By the 20th century, industrialization led to the mass production of bread with standardized fermentation, using dry and instant yeasts.

Today, baker's yeast (*Saccharomyces cerevisiae*) remains the most common, though wild yeast and bacteria in sourdough are also popular for their unique flavors and health benefits. The use of microbes has revolutionized the baking industry, allowing for consistent, efficient, and diverse bread-making.

The Microbial Architects of Baking: Building Flavour, Texture and Rise

The baking industry relies heavily on microbes to create the diverse range of breads, pastries, and other baked goods that we enjoy every day. From the tiny yeasts that make dough rise to the bacteria that develop distinctive flavors, these microorganisms play an essential role in the transformation of raw ingredients into delicious baked products.

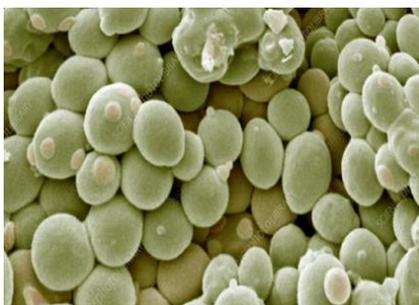
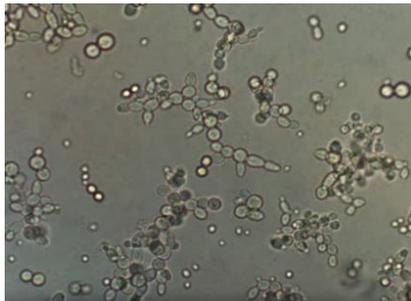
1. Baker's Yeast (*Saccharomyces cerevisiae*)



The most well-known microbe in baking is the baker's yeast, scientifically known as *Saccharomyces cerevisiae*. It is a single celled fungus that has been cultivated and refined over centuries for use in baking and brewing. This yeast is utilised in majority of commercial bread production around the world.

Role in Baking

Baker's yeast function mainly as leavening agent. During fermentation, the yeast consumes sugars in the dough and converts them into carbondioxide (CO₂) and alcohol by the process called fermentation. The CO₂ gets trapped in the dough, causing it to rise and making it to a light and spongy texture. The alcohol produced during the process contributes to the flavor profile of the bread. It is used in both home baking and commercial bread production for making soft loaves, buns, and sweet pastries.



Microscopic view of yeast

2. Wild Yeast

Wild yeasts are the naturally occurring yeast strains found in the environment, on flour and even on the skin of fruits. They are commonly

used in artisanal bread-making, particularly in sourdough fermentation.

Role in Baking

Wild yeast takes more time to ferment and produce more complex flavors. Hence it doesn't work as efficiently as baker's yeast. But this slower process allows the dough to develop a more nuanced, tangy flavor profile due to the production of both alcohol and organic acids.

3. Lactic Acid Bacteria (LAB)

Lactic Acid Bacteria (LAB) are a group of bacteria commonly found in fermented foods. They are integral to the sourdough fermentation process and they work along with the wild yeast. Species like *Lactobacillus sanfranciscensis* and *Lactobacillus brevis* are prevalent in sourdough cultures.



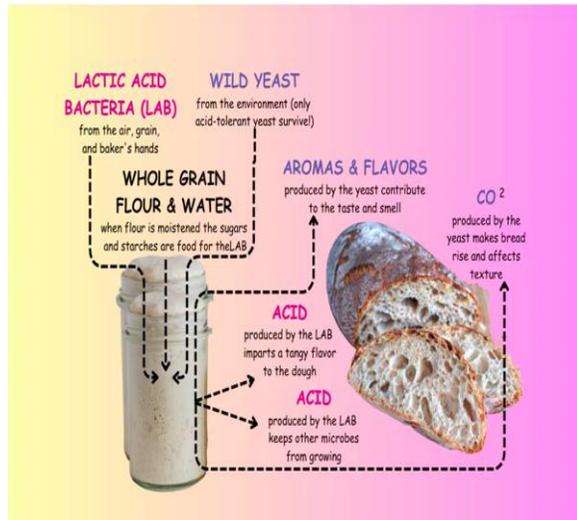
Role in Baking:

LAB ferment sugars and produce lactic acid and other byproducts. The lactic acid is responsible for the distinct sour flavor that defines sourdough bread. These bacteria also produce other compounds that help with the dough's structure, moisture retention, overall texture and also in preservation where lactic acid acts as a natural preservative which lowers the pH and creates an environment that inhibits the growth of spoilage microbes.

4. Acetic Acid Bacteria (*Acetobacter* species)

Acetic acid bacteria are a group of bacteria that include species such as *Acetobacter aceti*.

These bacteria are also involved in sourdough fermentation but they contribute differently than lactic acid bacteria.



Role in Baking:

Acetic acid bacteria convert alcohol (produced by yeast) into acetic acid, which is similar to vinegar. This gives sourdough and other fermented breads their distinctive sharp, tangy flavor.

Acetic acid bacteria thrive in the same acidic environment created by LAB, and together, they help balance the dough's acidity and enhance flavor.

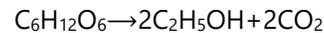


The Science of Fermentation in Bread-Making

Bread-making is a fascinating blend of science and art, where simple ingredients like flour, water, yeast, and salt are transformed into a delicious, airy loaf.

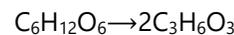
When flour meets water, enzymes (amylase) break down starch into sugars. This leads to the action of microbes such as yeast and bacteria which consumes the sugar and produces CO₂ (makes the dough rise-fermentation), alcohol, acids and enzymes that develops flavor, texture and aroma.

Equation for Alcoholic Fermentation:

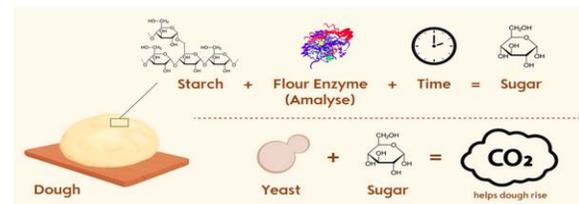


(Glucose → Ethanol + Carbon dioxide)

Equation for Lactic Acid Fermentation



(Glucose → Lactic acid)



Microbial Technology in Modern Baking

Microbial technology has revolutionized the baking industry, enhancing flavor, texture, and efficiency. This is done through:

1. Genetically Engineered Yeast:

Modern bakeries use genetically modified yeast strains that ferment faster, produce more gas, and enhance the flavor of bread, allowing for quicker and more consistent results.

2. Lactic Acid Bacteria (LAB):

Which is used in sourdough and probiotic breads not only creates tangy flavors but also offers gut health benefits. The controlled fermentation using specific strains of LAB can produce consistent flavors and improve digestibility.

3. Enzyme Technologies:

Microbial enzymes, like amylases and proteases, are added to dough to improve texture, increase shelf life and enhance dough

performance by breaking down starches and proteins.

4. Bioprocessing:

Fermentation-based leavening replaces traditional chemical agents, making dough rise more naturally. Continuous fermentation systems allow for faster production, improving efficiency in large-scale baking.

5. Sustainability:

Microbial processes help reduce waste by turning by-products into valuable materials like biofuels or animal feed, and microbial fermentation can also replace synthetic ingredients with more sustainable, eco-friendly alternatives.



Modern Bread Making

Future Prospects of Microbial Technology in Baking Industry

1. Personalized Baking: It involves customizing bread to meet the individual health requirements or dietary preferences.

2. Probiotic Bread: It deals with the addition of good bacteria that benefits the digestive system thereby obtaining gut friendly breads with health benefits.

3. Faster Fermentation: Advancements in bioprocessing and real-time microbial monitoring for efficient production.

4. AI Integration: Artificial intelligence can be utilised to optimize fermentation process and improve bread quality.

5. Genetically Engineered Yeast: Tailored yeast strains can be used for faster fermentation and unique flavors.

CONCLUSION

Behind every loaf of bread is a bustling microbial metropolis. These tiny organisms have transformed baking from a basic survival task into a refined culinary art. Whether it's the quick rise of a commercial loaf or the tangy complexity of sourdough, microbes are the quite artists behind it. So the next time you bite a warm, crusty bread, remember!!-you are tasting a masterpiece created by the smallest chefs on Earth.

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