



Food Microbiology

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Food Biology

- o Food Biology applies molecular genetics, biochemistry, microbiology, and sensory science to the understanding of biological processes that affect food quality.
- o Changes in micronutrients during processing and food preparation.
- o Food and nutrition policy issues are also an area of interest.

Uses Of Microbes

- Microbes make compounds called enzymes that we use in making hundreds of products. These enzymes can be get from bacteria for making soy sauce, soda, beer, wine, cheese, infant formula, chewing gum, leather goods, paper, laundry detergent, and even the stone-washed look on blue jeans.
- Such as, fungi (*Aspergillus niger*) make large quantities of enzymes, some of which are used to turn animal hides into leather goods.
- Fungus *Aspergillus oryzae* and *Kluyveromyces lactis* produce lactase, an enzyme that breaks down lactose, enabling people with lactose intolerance to drink milk.

Beneficial Microbes

- **Lactobacillus acidophilus:** belongs to a group of beneficial bacteria that reside naturally within the human intestinal tract and vaginal canal. As a member of the gut flora, *Lactobacillus acidophilus* performs important functions such as synthesizing vitamin K, producing anti-microbial agents, and fermenting dietary fiber. Yogurt is a great source of *Lactobacillus acidophilus*.

Beneficial Microbes

- o *Arbuscular mycorrhizas* is a soil-living fungus which helps crops take up nutrients from the soil.
- o The distinctive flavor and rich smell of soy sauce is made with the help of fungus *Aspergillus oryzae* *Zygosaccharomyces rouxii* and *Torulopsis* species.
- o Fungus *Saccharomyces carlsbergensis* breaks down the natural sugars in grains to form ethanol.
- o The bacterium *Pseudomonas putida* cleans waste from sewage water at water treatment plants.
- o A *Lactobacillus acidophilus* bacterium breaks down sugars and carbohydrates in milk, turning it into yogurt.
- o Marine bacteria are used as one of the tools to clean up oil spills. These bacteria chow on the oil, turning it into carbon dioxide and other harmless by-products.
- o *Escherichia coli* is one of many kinds of friendly microbes that live in our gut and help us digest our food every day.

Helpful Bacteria

- *Bacillus thuringiensis*: is common soil bacterium which acts as a natural pest-killer in gardens and on crops.
- The bacterium *Propionibacterium freudenreichii* produces carbon dioxide gas (CO₂) bubbles that burst in ripening cheese, leaving this cheese's trademark holes.
- The bacterium *Xanthomonas campestris* produces a slimy outer coating called xanthan. Xanthan gum is used as a thickening and stabilizing agent in many common products including water-based paints and cosmetics.
- Methanotrophic bacterium eats methane gas to clean up hazardous waste dumps and landfills. These methane-munching bacteria make an enzyme that can break down more than 250 nasty pollutants into harmless molecules. More methanotrophs means faster pollution break up.
- The bacterium *Acetobacter* modifies glucose, making vitamin C as a by-product.
- *Streptomyces* is a soil bacterium that makes streptomycin, an antibiotic used to treat infections. Fungi and bacteria produce powerful antibiotics such as penicillin and tetracycline. These are drugs we use to fight off nasty bacteria that cause sore throats, ear infections, diarrhea and other discomforts.

Improve Quality Of Life

- o Probiotics are living organisms that, when consumed, have beneficial health benefits outside their inherent nutritional effects.
- o Lactobacillus and other lactic acid bacteria may possess potential therapeutic properties including anti-inflammatory and anti-cancer activities, as well as other features of interest.
- o Bifidobacteria are considered as important probiotics, and are used in the food industry to relieve and treat many intestinal disorders.

Probiotics

- There is a growing body of evidence for the role of probiotics in gastrointestinal infections, irritable bowel syndrome and inflammatory bowel disease.
- Lactic acid bacteria (LAB) and bifidobacteria are the most common types of microbes used as probiotics.

Lactobacillus

- In recent years, much interest has been shown in the use of lactobacilli as probiotic organisms and their potential for disease prevention in humans and animals.
- Lactobacillus species are used for the production of yogurt, cheese, sauerkraut, pickles, beer, wine, cider, chocolate and other fermented foods, as well as animal feeds such as silage.
- Starter Cultures: pure cultures of bacteria, molds, or yeast. Inoculated into substrates for bulk processing, as in the preparation of food, beverages, and pharmaceuticals.

What microbes have you been eating?

- Without microbes, eating would not be fun. Many tasty foods, including cheese, chocolate, tea, bread, root beer, and many others are produced.
- Microbes are used to help preserve foods. Many microbes preserve foods by a process called "fermentation." Fermentation is the conversion of sugars to simpler compounds by microbes under conditions with no oxygen. Microbes gain energy in this process, just as we gain energy by breathing.
- Food Fermentations: addition to and growth of known cultures of microorganisms in food to produce desirable flavors, smells, or textures.

Ex: cheeses, breads, alcoholic beverages, and pickles

Some of the fun foods include:

Beer - Grains, such as barley, are converted to beer with the help of yeast. Hops, (flowers of hops vine), are added for flavoring and to prevent the growth of unwanted microbes that would otherwise ruin the beer.

Wine - Fruit juice is converted to wine with the help of yeast. The same microbe used to make wine can also be used to make bread.



- o Yeast - *Saccharomyces cereviceae*, or yeast, is a fungus. When grown without air, yeast produces alcohol (ethanol).

- o Bread - The same organism used to make beer can also be used to make bread. Bread is made from grains fermented with yeast. Kneading bread gives oxygen to the yeast so it can produce carbon dioxide so bread will rise. The yeast produce the gas carbon dioxide and the alcohol ethanol. The carbon dioxide gas makes the bread rise. The ethanol evaporates during baking.

- o Leavening: to lighten food materials by entrapping gas generated within it.
oEx: the rising of bread, from the CO₂ produced by yeast or baking powder.



- o Chocolate - Chocolate is prepared with the help of microbes.
- o Chocolate comes from the seeds of cacao trees.
- o These seeds are in a white fleshy pod. To get the seeds out of the pod, the pod is allowed to ferment with naturally occurring microbes that include yeasts and bacteria that produce an acid that helps to eat away the seed pod cacao beans.



- o Natto - A favorite food of some Japanese, natto is served with rice. This mucus-like mush that smells like ammonia is made by the action of microbes on soybeans that have been soaked in water.



o Yogurt - Yogurt is made from fermented milk. Milk is rich in sugars, particularly the sugar lactose. Since microbes like sugars, milk is a great feast for microbes. Lactobacilli are the bacteria that convert milk to yogurt. In the process of using the milk sugar.

o Lactobacillus produces acid which makes the yogurt sour and a less suitable place for other microbes



Curd: the coagulated milk protein used in cheese making.

Whey: the residual fluid from milk coagulation that separates from the solidified curd.

Rennin: the enzyme casein coagulate, which is used to produce curd in the processing of milk and cheese.



Bifidobacterium

- o Bifidobacteria exert a range of beneficial health effects, including:
 - o regulation of intestinal microbial homeostasis
 - o inhibition of pathogens and harmful bacteria that colonize and/or infect the gut mucosa
 - o modulation of local and systemic immune responses
 - o repression of procarcinogenic enzymatic activities within the micro biota
 - o production of vitamins
 - o bioconversion of a number of dietary compounds into bioactive molecules

Interaction

- o "Food is fermented or otherwise chemically changed by the addition of microbes or microbial products to alter or improve flavor, taste, or texture." (Microbiology Book)
- o "Common substances such as bread, cheese, beer, wine, yogurt, and pickles are the result of food fermentation's"
- o When you make bread, cheese, alcoholic brews, yogurt, milk, and vinegar they depend on the inoculation with starter cultures.
- o Baker's Yeast "*saccharomyces cerevisiae*" is what is used to make must breads leaven. Without leavening bread dough remains dense, flat, and hard.
- o Sour Dough gets it's distinct flavor from "*Lactobacillus sanfrancisco*"

Possible Careers

- - **FOOD SCIENTIST.** "Food scientists create new foods and innovative processes. Working independently or as part of a team, a Food Scientist applies basic scientific principles to practical problems associated with the preservation, storage, quality and safety of the food supply. A food scientist works in a highly competitive and sophisticated industry, incorporating new technologies, processes, packaging and transportation strategies. Food production at all levels is growing and evolving at a phenomenal rate to meet the basic requirements of an expanding world population. Food Scientists look for cost-effective ways of using the food supply to feed the world."
- - **FOOD MICROBIOLOGIST.** "A food microbiologist is a scientist who focuses on the microorganisms found in food. This can concern beneficial microorganisms, such as the helpful bacteria in yogurt, or harmful microorganisms such as E. coli and salmonella"
- - **FOOD INSPECTOR.** "As a food inspector you will collect samples of products for bacteriological and chemical laboratory analysis."

Advancement In Technology

- o The contribution of biotechnology has helped produce probes that detect pathogenic organisms much faster than conventional methods.
- o Also, the dairy industry has benefitted from the advances in biotechnology by acquiring the ability to determine the genetic basis for the bacterial metabolism of lactose in milk and to stabilize it.
- o In addition, enzymes that accelerate the aging of cheese have become commercially available, making it possible to produce a cheese with the taste of 9-month-old cheddar in just 3 months.

Vocabulary

- o Food Fermentations: addition to and growth of known cultures of microorganisms in food to produce desirable flavors, smells, or textures.
- o Ex: cheeses, breads, alcoholic beverages, and pickles.
- o Starter Cultures: pure cultures of bacteria, molds, or yeast. Inoculated into substrates for bulk processing, as in the preparation of food, beverages, and pharmaceuticals.
- o Leavening: to lighten food materials by entrapping gas generated within it.
- o Ex: the rising of bread, from the CO₂ produced by yeast or baking powder.
- o Malting: the grain, usually barley, which is sprouted to obtain digestive enzymes and dried for making beer.
- o Mash: in making beer, the malt grain is steeped in warm water, ground up, and fortified with carbohydrates to reform mash.
- o Wort: the clear fluid derived from soaked mash that is fermented for beer.
- o Hops: the ripe, dried fruits of the hop vine that is added to beer wort for flavoring.
- o Lagered: the maturation process of beer, which is allowed to take place in large vats at a reduced temperature.
- o Must: juices expressed from crushed fruits that are used in fermentations for wine.
- o Curd: the coagulated milk protein used in cheese making.
- o Whey: the residual fluid from milk coagulation that separates from the solidified curd.
- o Rennin: the enzyme casein coagulate, which is used to produce curd in the processing of milk and cheese.