22.5B: Early Biotechnology: Cheese, Bread, Wine, Beer, and Yogurt

Some of the earliest biotechnology used prokaryotes for the production of food products such as cheese, bread, wine, beer, and yogurt.

Learning Objectives

• Discuss the origins of food biotechnology as indicated by the production of cheese, bread, wine, beer, and yogurt

Key Points

• Prokaryotes and other microbes are beneficial to some food production by transforming textures, providing flavors, producing ethanol, and providing protection from unwanted microbes.
• Bacteria breakdown proteins and fats into a complex mix of amino acids, amines, and fatty acids; this processing alters the food product.
• Many food production processes rely on the fermentation of prokaryotes and other microbes to produce the desired flavors; in the case of beer and wine, they also affect the desired amount of ethanol.

Key Terms

• fermentation: an anaerobic biochemical reaction, in yeast, for example, in which enzymes catalyze the conversion of sugars to alcohol or acetic acid with the evolution of carbon dioxide
• biotechnology: the use of living organisms (especially microorganisms) in industrial, agricultural, medical, and other technological applications
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According to the United Nations Convention on Biological Diversity, biotechnology is “any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.” The concept of “specific use” involves some sort of commercial application. Genetic engineering, artificial selection, antibiotic production, and cell culture are current topics of study in biotechnology. However, humans have used prokaryotes before the term biotechnology was even coined. Some of the products are as simple as cheese, bread, wine, beer, and yogurt, which employ both bacteria and other microbes, such as yeast.

Figure (PageIndex(1)): Products made using prokaryotes: Some of the products derived from the use of prokaryotes in early biotechnology include (a) cheese, (b) wine, (c) beer and bread, and (d) yogurt.

Cheese production began around 4,000–7,000 years ago when humans began to breed animals and process their milk. Fermentation, in this case, preserves nutrients because milk will spoil relatively quickly, but when processed as cheese, it is more stable. A required step in cheese-making is separating the milk into solid curds and liquid whey. This usually is done by acidifying the milk and adding rennet. The acidification can be accomplished directly by the addition of an acid like vinegar, but usually starter bacteria are employed instead. These starter bacteria convert milk sugars into lactic acid. The same bacteria (and the enzymes they produce) also play a large role in the eventual flavor of aged cheeses. Most cheeses are made with starter bacteria from the Lactococci, Lactobacilli, or Streptococci families. As a cheese ages, microbes and enzymes transform texture and intensify flavor. This transformation is largely a result of the breakdown of casein proteins and milkfat into a complex mix of amino acids, amines, and fatty acids. Some cheeses have additional bacteria or molds intentionally introduced before or during aging. In traditional cheesemaking, these microbes might already be present in the aging room; they are simply allowed to settle and grow on the stored cheeses. More often today, prepared cultures are used, giving more consistent results and putting fewer constraints on the environment where the cheese ages.

Records of brewing beer date back about 6,000 years to the Sumerians. Evidence indicates that the Sumerians discovered fermentation by chance. Wine has been produced for about 4,500 years. The production of beer and wine
use microbes, including both yeast and bacteria, to produce ethanol during fermentation as well as provide flavor to the beverage. Similarly, bread is one of the oldest prepared foods. Bread-making also uses the fermentation of yeast and some bacteria for leavening and flavor. Additionally, evidence suggests that cultured milk products, such as yogurt, have existed for at least 4,000 years. These products use prokaryotes (as with cheese) to provide flavor and to protect the food product from other unwanted microbes.