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Fermentation: The Natural Solution

In 1768, the British explorer John Cook led a crew around the world to be the first European to discover and map the eastern coast of Australia. To avoid scurvy, a prevalent affliction during long voyages of the time, he wisely packed sauerkraut. This fermented cabbage could stay well-preserved and supply a plentiful source of vitamin C throughout the long journeys. Fermentation was coined by Louis Pasteur a century later to describe the effect of the anaerobic growth of yeast on food, although the process extends to any anaerobic breakdown of sugar molecules that is catalyzed by bacterial enzymes and produces energy. In the twentieth century, scientists discovered that fermentation occurs in muscle cells, allowing them to harvest energy from glucose in low-oxygen conditions, particularly intense exercise. Extensive research has revealed how much fermentation improves the quality and storage-life of food, and scientists are researching how fermentation can be applied to green energy and industry. The process of fermentation is the most important discovery because it has timeless relevance and a broad range of applications.

Although the process of fermentation was not understood until the twentieth century, it has been used for thousands of years to preserve food. In historical texts, the lack of references to water in contrast to the number of references to alcohol reflects the importance of alcoholic beverages. Since ten millennia ago, fermented beverages were the main drinks in civilizations that lacked clean water (Vallee, 1998). Even in areas of abundant freshwater, human waste polluted drinking water with microorganisms that caused infectious diseases; in particular, dysentery, cholera, and typhoid were major causes of death (Vallee, 1998). Fermentation lowers pH, consequentially killing the pathogens and inhibiting future decay. Such food preservation was vital to avoid starving throughout the winter months. Fermentation is a convenient, easy method of food preparation and storage that was especially useful before modern techniques, notably refrigeration and the use of chemical additives, were invented.

Fermentation increases the amount of bioavailable nourishment in various foods. The process removes over 90% of the anti-nutrients that prevent the absorption of minerals from legumes, grains, and seeds, and the process adds organic acids, such as lactic acid and ascorbic acid, which enhance iron and zinc absorption (Hotz, & Gibson, 2007). For instance, Martinez-Villaluenga, et al. (2009) increased the ascorbigen content of cabbage by twenty-fold through fermentation. Hence, fermented foods improve the diets of vegetarians or people in developing countries who lack a nutritional source of dairy or meat because of economic, religious, or personal reasons. Furthermore, fermentation cultivates optimal conditions for the growth of probiotics, which provide vitamins, synthesize organic acids, make antibiotics, and hydrolyze key proteins to contribute to a range of health benefits. Probiotics replenish our bodies with healthy bacteria and prevent the growth of pathogens among those undergoing antibiotic treatment. For example, *Lactococcus lactis subsp. Lactis*, regularly used in cheese-production, produces the bacteriocin lacticin 3147 that kills *Clostridium difficile*, which proliferates in post-antibiotic-therapy environments and causes diarrhea (Petherick, 2013). Similarly, probiotics boost pasteurized substances with healthy bacteria. While pasteurization of raw milk destroys its nutritive components, fermentation of pasteurized milk into yogurt resupplies a source of helpful bacteria. Recent research has revealed additional protective health benefits of fermented foods.

Fermentation also supplies regulatory biomolecules that protect our health. Fermented milk-products contain the angiotensin-converting enzyme inhibitory peptides that are commonly used in drugs for hypertension, and they provide anti-clotting molecules, such as k-casein (Petherick, 2013). Several studies show that such dairy products can greatly reduce blood pressure without the adverse side effects of expensive drugs (Fitzgerald, Murray, & Walsh, 2004). Moreover, fermentation of milk releases sphingolipids, which have been shown to kill cancer cells and inhibit tumor growth (Parodi, 1997); further research has offered roles for this important regulatory molecule as an anticancer agent and in therapy (Delgado, Fabrias, Bedia, Casas, & Luis, 2012). Fermentation has even been shown to alleviate the negative effects of consuming too much dairy on people with hypolactasia, a condition that affects nearly 70% of the global population (Lomer, Parkes, & Sanderson, 2008). Thus, lactose intolerant people can consume greater amounts of dairy if it is fermented. Such health-benefits of fermented foods have been well-studied and well-documented.

The potential of fermentation extends beyond food applications. First, microbial fermentation reduces the volume and odor of sewage, and it removes pathogens from organic wastes. This method of disposal leaves a harmless, soluble substance, which can then be used to produce fertilizer, and it yields hydrocarbon gases, such as methane, which can be harvested for energy. Second, microbes produce green biofuels during fermentation. For example, c*lostridium ljungdahli* breaks down simple hydrocarbon molecules, including the greenhouse gas CO_2, to produce biofuels. Scientists have succeeded in genetically altering this bacteria to cause them to generate butanol instead of ethanol, furthering the development of a fuel that potentially uses more CO_2 than it releases. Many companies are interested in the potential of such carbon-neutral fuel production by other microbes (Biello, 2010).

Although nutritional supplements and modern food preservation methods, including refrigeration or chemical preservation, help alleviate the problem of malnutrition and food spoilage today, fermented foods remain the healthiest organic, affordable, and simply-prepared aliment. Nutritious eating deserves more attention, especially because the frequency of obesity, hypertension, and diabetes may correlate with the widespread consumption of low-cost and often less salubrious alternatives. Wholesome diets include a source of good bacteria to support the millions of microbes that help us function well. Contrary to popular belief, not all bacteria are harmful; rather, bacillophobes do a disservice to their health by avoiding fermented foods. In addition, fermentation remains current through environmental-friendly waste disposal and clean energy research. As the global population increases, the demand for quality sustenance, energy, and a reduced environmental impact increase dramatically. Fermentation is well-established process that has the potential to solve these problems in the future.

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