

CHAPTER 9

Fernentation BIOTECHNOLOGY



Fermentation isn't for homesteaders or those who want a healthy dose of gut protecting microorganisms. It may be one of the oldest biotechnologies humans have used and will probably play a major part in our history yet. In the past few years, we've seen food trends hit the market harnessing this very technology, from Kombucha a fermented black tea that many claim aid in digestion, to kefir, a fermented milk drink which teams with a number of health benefits. Its played major roles in the health industries, producing insulin, vitamins, steroids, amino acids, enzymes, lipids, and biopharmaceuticals, to the manufacturing of dyes (BioNetwork, 2013).

Fermentation converts organic substances using bacteria, fungi, culture or by adding enzymes (burnet). In foods this can result in increased flavour, shelf-life and health benefits (Masterclass, 2021)

To think where Windsor & Essex County would be without the process of fermentation would be hard to fathom. Very neighbourhoods, railroad tracks, industries and factories have been built, a booming economy was created as the U.S. prohibition roared, and for over 200 years, this biotechnology has supported life in Windsor/Essex... and it may prove to do so again. Our story starts off with the establishment of Hiram Walker, a spirits production company who created the brand "Canadian Club Whiskey" by fermenting grains. To support workers, he established Walkerville, where worker housing is still used today. The industry still runs strong under the brand "Hiram Walker & sons Ltd." and since we've added the 18 wineries, 14 breweries and over 2 spirit distilleries, all using the same process Hiram Walker did to produce a similar product.

The wineries, beer breweries and spirit distilleries can only produce their products through fermentation, because ethanol is created from a metabolic waste product (BioNetwork, 2013), which is essentially what creates alcohol such as beer or wine. In fermentation, the product that cells manufacture can be the chemicals that cells naturally have, substances that cells have been genetically altered to create, or like alcohol, a metabolic waste product of the organisms growth (BioNetwork, 2013).

The 3 types of fermentation includes (Masterclass, 2021):

- Lactic Acid fermentation
- Ethanol/Alcohol Fermentation
- Acetic Acid Fermentation

Fermentation follows a general guideline of steps in order to yield the final product which need to meet strict environment requirements like Temperature, pH, Nutrition levels, pressure, and oxygen (BioNetwork, 2013). To first start fermentation a cell must be chosen which would be specific to the desired product. A bacteria, fungi, or culture are usually used. The cells are then introduced into a medium, a source of nutrients to help the cells grow. When the majority of nutrients are consumed, the cells are moved to a larger vessel with more growth media. This is referred to as scaling up. When the quantity of cells is large and healthy enough its transferred into a production vessel known as a bioreactor or fermenter. At this point fermentation begins its growth pattern.

- 1. Lag Cell adapts to environment which creates a lull in the growth timeline.
- 2. Exponential/Log The cells divide and double and double again, growing logarithmically
- 3. Stationary Nutrients become scarce. As many cells are dividing as they are dying. This is the point where fermentation stops and the fermented broth harvested.
- 4. Death More cells die than divide, logarithmically

To see how this process is actually used in industry, we'll compare the procedure of two products that use fermentation: vaccine production by observing how the Covid-19 vaccine was manufactured, and fermentation in wine which is used by the 18 wineries in Essex County.