17.4B: Vinegar

Vinegar is a food product made by acetic acid bacteria that can ferment the alcohol in alcoholic liquids to acetic acid.

Learning Objectives

• Describe how vinegar is made and the common uses of vinegar

Key Points

• The fermentation of alcohol requires oxygen and its availability can determine the rate of vinegar production.
• The main genus used for vinegar fermentation is Acetobacter sp. since the final product of its fermentation can contain acetic acid as high as 20%.
• Some of the most common uses of vinegar are in food preparation, as a cleaning agent, and as a medicine.

Key Terms

• starter culture: Starter culture consists of live microorganisms with some medium used to start fermentation or growth in a fresh new medium (substrate).

Vinegar has been used for cooking and in the household and different industries due to its mildly acidic nature for many centuries. It is one of the foods together with beer, wine, bread and fermented dairy products, that is the result of fermentation by microorganisms and has been around for thousands of years. It is a mixture of acetic acid (most often 5%) and water.
The fermentation is performed usually by acetic acid bacteria, from the genus *Acetobacter*, from the alcohol in variety of sources (e.g., apple cider, wine, potatoes, fermented grain). *Acetobacter* bacteria are Gram negative aerobic rods. They are naturally present in environments where alcohol is being produced and can be isolated from damaged fruit, apple cider, etc. In these liquids, the bacteria form a film on the surface, since they are aerobic and need good oxygen supply. This film, called mother of vinegar, can be used as a starter culture of acetic fermentation in fresh alcohol liquids. Mother of vinegar can also be found in unpasteurized store brand vinegar. Acetic acid bacteria are transmitted in nature by vectors like fruit flies and Vinegar eels.

Figure: **Mother of vinegar**: Mother of vinegar is used as a starter culture for vinegar production. It is made of a specific cellulose and acetic acid bacteria

This acetic acid fermentation needs oxygenation. If left at room temperature alcohol containing solution with *Acetobacter* will be converted to vinegar in months. The industrial process can be completed within hours since air is bubbled and mixed through the solution.

Vinegar can also be an undesired product in wine production. If the temperature in the fermentation vessel is too high, the *Acetobacter* will outgrow the yeasts and the produced alcohol will be converted to vinegar.

There are bacteria that can convert sugars straight to acetic acid in anaerobic fermentation. Such species include *Clostridium* and *Acetobacterium* but they can not tolerate acetic acid of concentrations higher than a few percent. The product made from these bacteria must be concentrated while oxidative fermentation by *Acetobacter* can produce up to 20% acetic acid.

Vinegar is a food product made all over the world from many different carbohydrate sources where alcohol fermentation has been performed. Some of them are more commonly used, such as apple cider and grapes, while others such as coconut water, dates, kiwifruit are used in specific regions of the world. Vinegar is used not only in food preparation but also as a cleaning agent due to its acidic nature and strong antibacterial properties. It can be used to lower the glycemic index of foods if consumed together with them. It has also been shown to reduce the risk of fatal ischemic heart disease when consumed frequently with oil in salad dressings.