# Fermentation as a sustainable method of food preservation

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**Abstract:**

In modern world food has been persevered by wide range of methods which involves variety of chemicals used as preservatives. These chemical preservatives are produced in laboratories by many methods. These preservatives are popular in food industries as they are cheaper, easy to manufacture, easy to apply, effectiveness, increases shelf life, prevents growth of pathogens in food. But the most significant drawback of using these chemically derived preservatives is its harmful effects on human health and well-being. They can cause damage to your body in a long run. Talking about the use of fermentation as a method of food preservation we saw that it is a way better option to preserve food because it doesn't have harmful after-effect during fermentation. In the contrary, fermentation leads to improvement of the food quality and safety. This article in detail about application of fermentation as a sustainable preservation method.

**Keywords:** Fermentation; Food; Preservation; Natural; Microorganisms

## Introduction

Humans have been using method of fermentation for many decades. Fermentation is a metabolic process in which substances undergo decaying in presence of microorganisms to produce desired compounds that can be utilized for improving food quality and safety. Preservation of food by the fermentation process is a great method to preserve foodstuffs even in industrial level. Fermentation not just prolong the shelf life of food but also has many added advantages like it improves the sensory properties of food and even improves the nutritional value of that food item. Therefore, fermentation increases the overall acceptance of the fermented food product (2, 7).

Fermentation is one the ancient food processing method. Food processing in modern world involves numerous ranges of food preserving methods and technology to maintain acceptable and quality level of food right from

processing till its consumption. Nowadays fermentation as a method of food preservation has gain attention which had been exploited since many years. This change has occurred due to the discovery of benefits of fermentation and fermented food items. Fermentation is also a cheap food preserving method which makes it to be deserving for its use in broad industrial levels (7).

**Fermentation- Historical Perspective**

Fermentation has been used by man for thousands of years. In Iraq around 6000 BC cheese production was developed. Later on, Egyptians found the use of yeast for leavened bread making wine production followed by discovery of beer from fermented barley by Sumerians then came the discovery of antibiotic from moldy soybean used by Chinese in 500 BC. Then first distillery of whisky was established in Ireland (3). In 1500 AD yogurt and sauerkraut fermentation is discovered. Pasteurisation which is a sterilisation process that involves heating and rapid cooling treatment was developed by Louis Pasteur in 1861AD. After all these discoveries *Nisin* as a preservative was discovered which is an inhibitory protein substance isolated during *cheese* making in England (3, 7).

**Fermentation of Food**

Fermentation is a controlled metabolic decaying process in which breakdown of carbohydrates (starch, sugars, etc) takes place in presence of microbes (molds, yeast, etc) occurs, resulting in formation of alcohol or acid. Bacteria produces lactic acid and yeast produces alcohol from carbohydrate fermentation (2).

During fermentation the food product undergoes many changes physically, chemically as well nutritionally.

- Fermentation is a natural way to preserve variety of food products.
- Fermentation enhances the organoleptic attributes of food like texture, flavour, aroma, etc.
- Preservation of food by fermentation improves the nutritional composition of the food product hence making it a better food product for consumption.
- Fermentation is a cost-effective method for food preservation as it needs smaller amount of starter culture which can ferment large amount of food at one go.
- Fermented food products boost our immune system by preventing pathogenic microbial infections in our body. Thus, it strengthens our overall well-being and health.

Keeping these benefits in mind, fermentation has gained popularity for industrial purposes and is being used in today's food industries as a potential preservation technique to preserve many food stuffs in a large scale for mass consumption and production (3, 5).

**Fermented Foods and its Preservation**

Fermented foods can be defined as the food which has been subjected to desirable physical and biological changes by the action of microbes (yeast, molds, etc) or enzymes that provides the food with significant modification of the food as a whole (5).

There are numerous varieties of fermented foods available in the market and prepared at home.

Beer, wine, cheese, yogurt, kefir, sauerkraut, natto, kimchi, pickles, soy sauce, miso, tempe, hamanatto, apple cider vinegar, kombucha, fermented- meat, fish, vegetables and many cereal products, and so on, these are mainly produced at large scale in food industries. However, they can also be prepared at home. Some more fermented products that are generally prepared at home are idli, dosa, dhokla, appam, fermented rice or kali, etc. (9). These fermented foods are widely consumed and fermentation leads to enhancement of its shelf life by acting as a food preservative technique.

***Cheese***

Cheese is a milk-based product obtained from casein (milk protein) coagulation. Milk contains lactose sugar which is subjected to fermentation to produce lactic acid by addition and action of bacterial starter culture (*Streptococcus cremoris, streptococcus lactis,* etc).

Milk is then left with coagulated casein proteins, then the separation of casein from whey is done. After this cheese is left for ripening by microbial action to obtain cheese followed by its proper packing (2).

Shelf- life of cheese is increased as a result of fermentation and it can stay unspoiled if kept in a proper way up to several weeks to several months.

***Wine***

Wine is an alcoholic beverage or liquid which is significant for both industries as well as for commercial purpose. Wine making starts with fruit selection – grapes which has important acids, esters and other compounds which are required to make wine naturally (4,6). Wine making starts with fruit selection – grapes which has important acids, esters and other compounds which are required to make wine naturally. Then squashing is done (mashing of grapes) to obtain pulp. Then it's the turn for fermentation which occurs naturally within some hours (6-12 hrs) by addition and action of yeast present in air (10). Fermentation is continued till dry wine is obtained by the transformation of sugar present in grapes to alcohol.

Fermentation occurs for longer period of time so it is stopped before whole of the sugar is converted to alcohol to get sweet wine. Lastly classification, bottling and aging process completes produced the final product (10). Fermentation of wine results in its longer shelf- life and if the wine is kept in a proper manner in appropriate conditions then it can stay unspoiled up to some days to years depending the type of wine.

***Soy sauce***

Soy sauce is a very popular food ingredient and is widely used in Chinese, Japanese and Indochinese cuisines. It is a dark coloured fermented liquid which is salty in taste and is a product of soy beans. To obtain good quality of soy sauce firstly soy beans are cooked for about 4-5 hours and then left for cooling. After this equal quantity of roasted and ground wheat is added. Then the mixture is seeded with *Aspergillus oryzae* for initial fermentation process followed by addition of salt (9). This whole mixture is left for maturation for about six months to three years when further fermentation occurs. The product is then finally strained and packed (9). Soy sauce due to fermentation preservation can be stored for about six months or more if kept in proper condition and temperature.

**Fermentation- As a food Preservation and its effect on Pathogens**

All food items contain micro-organism of different types and origin. Their number, domination, presence and absence depend on various significant factors (6). They may be lower in number initially in a food item but they can further grow and multiply if there is availability of favourable conditions and environment. Likewise, lactic acid bacteria (LAB) which is being used widely in fermentation and preservation process of food items

can inhibit the growth of other microbes and will dominate in that environment in a food item. LAB includes Lactobacillus, Lactococcus, Leuconostoc, Streptococcus species which produces lactic acid as a result of fermentation. Preservation by fermentation using LAB has many additional benefits as it has properties of detoxification, improve immune system of humans, and so on (6, 7).

The enterococcus genus a member of Lactic acid bacteria can be found in different environments, mostly in human and animal intestines. They are used form many decades in fermented food preparation and also got the use to make probiotic starter cultures. Now, many studies are going on to find its application as a bacteriocin for food preservation and to prevent pathogens. Some studies have shown that it has its active effect against Gram negative strain of bacteria and also on *Listeria monocytogenes* (3). Preservation by fermentation is an effective and desirable method of food preservation to extend the shelf life of food products. LAB has a wide application in food industries for fermentation, preservation and improvement of food quality overall (8).

These micro-organisms can use a wide variety of metabolites including organic acids (*propanoic acid, acetic acid,* etc), diacetyl, carbon-di-oxide and even antibiotics reutrocyclin produced by *lactobacillus reutri.* Additionally, they can also produce wide variety of bacteriocins, which have their action against pathogenic micro-organism *(Listeria monocytogenes, Clostridium botulinum, etc.)* present in food. (1, 4)

Nisin is a bacteriocin and is a preservative which is an inhibitory protein substance discovered and isolated during cheese making. Nisin has been used for many decades as a biopreservative in food products specially in dairy products and is the only bacteriocin which has been practically applied in food industries to process food, whereas Lacticin 3147 which is also a biopreservative discovered recently has many applications in food industries and is used for many food products (4, 6).

Both these bacteriocin which is derived from lantibiotic family contains β- methyllanthionine, lanthione and dehydrated amino acids. These antagonists have excellent potential to inhibit the growth of harmful and disease-causing pathogens and can make a food item safe to consume and extending its shelf life by acting as a great and natural food preservative (7, 8).

**Conclusion**

Fermentation is a pocket friendly natural food preserving method and it also improves the organoleptic properties, enhances nutritional value and composition of food, improves health by enhancing immune system response and so on. Therefore, more research should be done on this topic to obtain tremendous benefits of fermentation which had been used by our ancestors. Fermentation must get proper application and place for preservation method in food industries widely.

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