Wines, Spirits and Fermentation

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For the purposes of this book, the author shall define "fermented foods" as any food, liquid or solid, obtained with the use of microorganisms.

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CHAPTER 1

The History of Fermentations

The word "fermentation" is derived from the Latin, "fervere" which means, "to boil" or "to be agitated." This may happen when certain microorganisms, especially yeasts, are added to a substance containing sugars, which they metabolize, producing alcohol and carbon dioxide. Today, most fermented foods and beverages are produced commercially by carefully controlled scientific technology. This was not so in antiquity. The microorganisms that carried out the fermentations were usually the normal flora of the substances to be fermented. If they were not present, there could be no fermentation. Today, the microorganisms can be purchased, or cultivated in the laboratory in large numbers and added to the substrate to be fermented to insure a satisfactory end product.

It is believed that the earliest fermented beverages were the accidental results obtained by mixing honey with water and other flavorings to yield, following fermentation, a "honey wine." This probably occurred over 10,000 years ago and preceded the later developed grape and fruit wines. Today, this beverage is called "mead" and is a wine, not a beer. Since sugar was not generally available, honey or fruit syrups were used as sweetners and, when diluted, allowed a rapid fermentation if the correct microorganisms were accidentally included.

The use of honey was widespread in antiquity as can be observed from the following words, indicating a common source: English–mead; Slavs–medhu; Indo-Europeans–mit; Sanscrit–madhu; Chinese–myit. Until the end of the Middle Ages, honey was the main sweetner utilized in Europe and other parts of the World. It was the by-product of monasteries and cottage industries who raised bees to get the wax for candle making. Mead was popular for thousands of years, especially in areas where grains, grapes and certain fruits were not readily available. In England, when the monasteries were dissolved in the 16th Century, mead fell out of general usage, and beers and wines became more popular. In India, honey was used for its flavor because sugar cane was available. When Alexander the Great traveled to India (@ 325 B.C.) it was recorded that there were plants that produced honey without the use of bees. The cultivation of the sugarcane was widespread in India by the 5th Century, B.C., and spread, Westward, slowly. In the 8th Century, A.D., the Moslems, conquering into Europe, spread sugarcane along the Mediterranean shores, but sugar still remained a rarity in Europe until the 16th Century.

It is possible to prepare mead by inoculating a 5–6% honey-water

solution with Baker's yeast, *Saccharomyces cerevisiae,* and allowing the fermentation to complete itself in a cool place. The resulting fermented beverage can be filtered and cooled. Unless consumed, the end result may be vinegar, due to the conversion of the alcohol to acetic acid by *Acetobacter* bacteria.

A Stone Age drawing depicting the gathering of honey, from a rock painting at Bicorp, Valencia.

The date palm flourished in several "Cradles of Civilization" where it grew along the rivers and irrigation canals. The dates could be eaten or the juice could be expressed and used as a sweetner or fermented into "date wine." Mead and date wine are thought to have preceded grape wine. The crown of the date palm may also be tapped and the sap can be fermented into "Palm toddy."

The grape vine, *Vitis vinifera,* is thought to have originated somewhere between southern Russia and Asia Minor and was under cultiva-

Picking grapes and watering the vines was depicted in a necropolis wall painting at Thebes, U.A.R. Author's photograph courtesy of the Egyptian Museum, Cairo.

tion in Mesopotamia and Egypt by 3500 B.C. According to legend, the grape was introduced into Egypt by Osiris; to the Hebrews by Noah; and to the Greeks by Dionysus/Bacchus. The great seafarers, the Phoenicians, are thought to have introduced the grape into Europe around 600 B.C., with later plantings by the Romans about 200 A.D.. The vine was widely cultivated in Europe by the 15th Century and was introduced to the New World by Spain and Portugal.

Grapes and wine were known in Mesopotamia, from which Bacchus fled because the majority of the people preferred beer; in Egypt,from pre-Dynastic times, in India and China. It was the Egyptians who really started the production of wines in a manner similar to that of today for the reason that they were able to manufacture a container in which the wine could be aged without spoiling.

Recently, some of the tomb treasures of the Pharaoh Tutankhamun toured the United States and were seen by millions of people. Not seen, were twenty-six wine jars found in the tomb which were labeled with the vineyard, vintner and the date. Twenty-two of the jars had contained dry wines and four, sweet. Naturally, the wines had evaporated. Tutankhamun ruled for approximately ten years, about 1345 B.C.. From the labels, the best wines were produced in the years 1345, 1344 & 1340 B.C.. The most outstanding vintage included was one from the time of his father, the Pharaoh Amenhotep III and was about thirty-five years old when placed in the tomb.

These, of course, are not the oldest examples of wine-making from Egypt. Complete, sealed wine jars have been found which date back to the First Dynasty that ruled Egypt, at about 3000 B.C.. These jars are the fore-runners of the amphorae later utilized by the Greeks and Romans to age, store and ship their wines. They had pointed bottoms, handles and a narrow top and opening that could be sealed with clay.

A Syrian type of wine jar from the tomb of the Pharaoh Tutankhamon, in the Valley of the Kings, U.A.R. Photograph courtesy of the Ashmolean Museum, Oxford.

A wine strainer from Ancient Egypt, about 2000 B.C. Author's photograph courtesy of the British Museum, London.

Servants carrying wine jars are depicted in this wall painting from the necropolis at Thebes. Author's photograph courtesy of the Egyptian Museum, Cairo.

In them, the famous Greek wines such as Pramnian, Lesbian and Saprias wines were aged. Later, the Romans adopted the Greek wine methods and some of their wines, such as the famous Falernians, were aged over 100 years. After the fall of the Roman Empire, the *amphorae* were no longer available and the wooden cask came into popular use. Since they were not air-tight, the wines could not be aged for long periods of time. The ability to age wines disappeared from the world for about 1500 years until the discovery of the *cork* in the 17th Century, and the development of the correct bottle in the 18th Century. The credit for the discovery is generally awarded to the Portuguese, who used the cork, bottle and horizontal storage to age their wines, Ports, in about 1780. The French, who had been supplying England with much of her wine, suddenly found themselves with a competitor and gradually adopted the bottle in which their wines could age. Apparently this procedure began with the Bordeaux *clarets* in about 1797 at Chateau Lafite, and gradually spread throughout the wine industry. Today, virtually all wines are made in this manner.(1)

The previous wines were all natural fermentations in that the substances would ferment by themselves due to the presence of microorganisms in the honey or on the fruits. However, how were these fermentations accomplished in antiquity? The first true pottery was made about 6000 B.C., so for thousands of years people carried out fermentations in very unusual containers. Pits in the ground lined with clay or stones; sea shells; turtle shells; hollowed stones; hollowed stumps or logs; gourds; or containers made from animal hides, stomachs or bladers.

(1) A History of Wine, H.W. Allen, Horizon Press, N.Y., 1961, page 220.

Dandelion Wine(1)

4–6 quarts of dandelion flower heads
2 gallons of water
4–6 pounds of sugar
6 lemons
6 oranges
1 tablespoon ground ginger or ½ oz. fresh ginger root
3 cups of cut raisins or 1 ½ pounds, cut fruits
yeast

1. Put dandelions, water and sugar into an unchipped enamel pot and bring to a boil for 30 minutes.

2. Strain and return liquid to pot.

3. Add the thin peelings of the oranges and lemons and ginger. Simmer for 30 minutes.

4. Pour cooled liquid into fermenter. Add juice from oranges and lemons. Add cut raisins or fruit. Add yeast.

5. Attach air trap and allow to ferment.

6. When fermentation is completed, allow to clear (or fine it). Bottle – age – drink.

Historically, the next group of fermented foods discovered by early man were the dairy products. This, however, required the domestication of animals that could produce large amounts of milk. It is believed that the Asiatic wolf and the goat were domesticated about 11,000 B.C., followed shortly after by sheep. The pig was utilized by about 7000 B.C., but like man, cannot digest grasses, leaves and twigs as the sheep and goats do. The cow came into use about 6000 B.C., but did not become popular as a dairy animal in Europe until about the 16th Century, replacing sheep.

The making of cheese was probably discovered in antiquity by someone who was carrying milk in the stomach of a young animal, which had been butchered and the stomach removed and tied at the ends in order to carry liquids. The stomach of such animals contains the enzyme rennet (rennin), which curdles the milk. The coarse curds could

(1) Any non-poisonous flower can be used.

have been pressed into baskets or pots or gourds for further maturation. A smooth curd could have developed in a container where microorganisms in the milk converted the milk sugar, lactose, into lactic acid, causing curd formation as found in sour cream or yogurt.

It is possible to prepare a simple type of "Cottage cheese" by heating four parts of milk, with one part of buttermilk, to about 170°F. for about one hour. When curds separate from the whey, remove curds and drain through cheesecloth, or something similar for several hours. Remove cheese, salt to taste, cover and refrigerate. The whey may also be consumed.

A more simple procedure, if raw milk is available, is to put the milk in a shallow container in the direct sunlight. (Cover with cheesecloth to keep insects out.) The heat from the sun will allow the microorganisms present to produce acids which will cause curd formation. The curds may be separated from the whey and formed into a variety of cheeses. In general, pasteurized milk will not work properly because some of the microorganisms were destroyed during the pasteurization process.

It is interesting that China never developed a dairy culture. Apparently, sometime about 2000 B.C., fermented milk products were classified as being unclean and were, along with other milk products, omitted from the diet. In general, all new-born babies produce lactase, an enzyme used in the utilization of lactose. If, the child is weaned and is no longer given milk, the child stops producing lactase and can no longer digest fresh milk. The child could, however, digest certain fermented milk products in which the lactose had been converted by microorganisms. These fermented products, however, were thought to be unclean.

Dairy products which have been fermented by microorganisms can be divided into several groups by their acidity and alcoholic contents. Those products containing less than 1% lactic acid are called "low acid" and include sour cream and buttermilk. Those products having 2–3% lactic acid are called "medium-high acid" and include the various yogurts (leben, matzoon, mazum, naja, dahi) and fermented milks (acidophilus, Bulgarian buttermilk, fru fru, gioddu, grusavin, kaimac, kos, skorup, tarho). The alcoholic products generally have 1–3% alcohol and include araka, fuli, kefir, koumiss, lang and puma.

One may prepare a fermented milk or yogurt by the addition of the proper microbial culture(s) or by this simple procedure. Heat the milk to almost boiling for a few minutes to destroy the microorganisms present, and then cover and cool to room temperature. Add a cup of the fermented milk or yogurt to the cooled milk, stir, cover and set in a warm place for about twelve hours. The resulting product should be similar to the inoculated milk or yogurt.

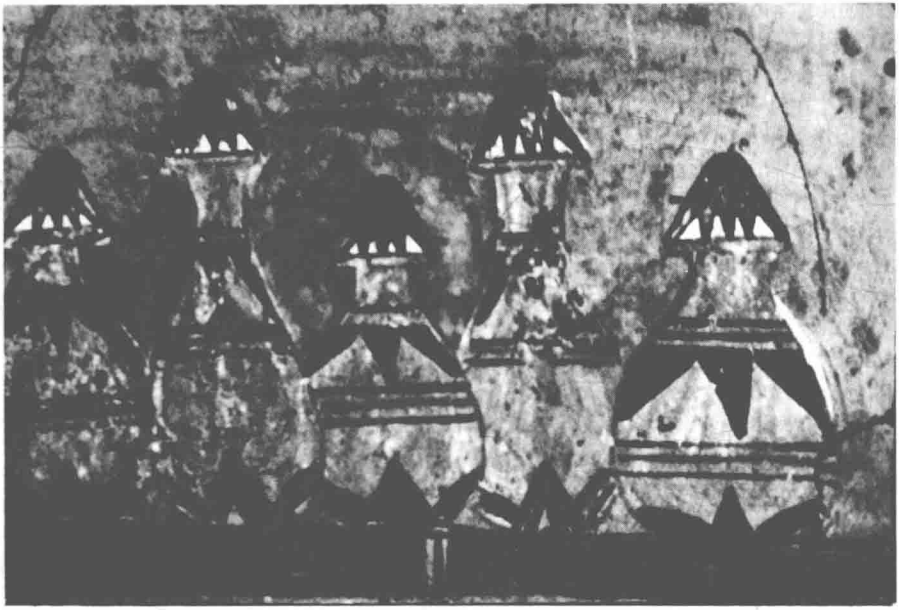
In about 1253, a traveler into China, William of Rubruck, reported on the preparation of a fermented milk from mares called "kumiss" by the Mongols. The similar product, prepared from camel-milk is "kephir" or from the yak, "airan." He reported that a quantity of fresh mare's milk was poured into a great bag which was then beaten with a piece of wood. It soon began to froth, like new wine, and became sour and had a sharp taste and they continued to beat it until butter was formed. Upon drinking it, it left a taste behind like almond-milk, was easily swallowed and intoxicated weak brains, for it was very heady and powerful.

When William of Rubruck arrived at Karakoram, the residence of the Mongol prince, Mangu Khan, he found a silver fountain with four spouts which provided the drinker with a choice of kumiss, mead, rice wine or wine.

During the Neolithic Period, it was discovered that raw grains could be utilized as human food by allowing them to sprout. It was then discovered that, if the sprouted grains were allowed to dry and then made into flour, the resulting breads kept better than those from unsprouted ground grains. It was then discovered that, if the partially baked breads from dried, sprouted grains were soaked in water and allowed to ferment, a "bread beer" could be produced. Further advances in technology allowed the preparation of beer without making bread. Prepare some bread beer and discover what it was like to live in 3000 B.C..

In Africa, in Egypt, recent discoveries near Aswan in 1979 indicate that humans began practicing agriculture about 17,000 years ago, 10,000 years earlier than previously thought. Barley grains found at the sites had been parched, apparently as a first step toward grinding them into flour.

In the Middle East, wild grains were being gathered about 8000 B.C. at Jarmo and other sites. The grains were separated from the chaff by rubbing between stones or threshing on heated stone floors. However, if the grains were threshed on heated floors, they would not sprout. Between 5–3000 B.C., grains were being cultivated in the other Cradles of Civilization around the world: China – rice, broom-corn, wheat, millet; Egypt – barley, millet, wheat; Mesopotamia – barley, millet; India – rice, barley, millet, wheat; Minoan – wheat, barley. The small seeded cereal and forage crops, such as barley and millet, due to their chemical composition, were unsuitable for leavening and it was not until a strain of wheat was developed in Egypt, that could be threshed without heating, that leavened or raised bread could be developed. The starchy endosperm of the wheat contains gluten-forming proteins which are elastic and stretch, when trapping the carbon dioxide produced by the yeasts which are converting the sugars from the grain starches, to



Ancient Egyptian wine jars as portrayed in the necropolis at Thebes, U.A.R. Author's photograph courtesy of the Egyptian Museum, Cairo.

Wooden models from Ancient Egypt portray bread and beer making. Author's photograph courtesy of the Egyptian Museum, Cairo.

alcohol and CO_2. The yeasts ferment the mono – and disaccharides present in the dough. Additional maltose is produced from the action of the amylases (enzymes) of the grains on the dextrins (carbohydrates) which are present. The alcohol produced during the fermentation, evaporates during the baking process. The yeast utilized in baking is *Saccharomyces cerevisiae.*

Although the special Egyptian wheat was grown about 3000 B.C., it was very rare around the Mediterranean Sea. Raised bread did not become common in Greece until the 4th Century, B.C. and was still uncommon in Europe in the Middle Ages. Another problem was that people did not know what caused the bread to rise, so known ferments were introduced into the dough such as beer, wine, grains soaked in wine or beer, sour porridges and pieces of dough kept from day to day. Today, to make special types of sour bread, fermentation with lactic acid producing microorganisms is used, in addition to the yeast fermentation.

It appears, historically, once the secret of sprouting grains was discovered, alcohol production followed. The beers produced were not like the ones consumed today since hops were not utilized to a great extent until the 15th Century in Germany.

Ale Posset

A traditional hot drink of Yorkshire, England, ale posset consists of
milk curdled with ale,
beer and wine,
and very often spiced.
It was the final beverage taken by families of old Yorkshire on Christmas Eve. As part of the annual ritual, each family member at this time would take a sip or "sup" for good luck.

According to legend, Dionysus fled the Fertile Crescent, going to Greece, because its people were so addicted to beer rather than wine. Basically, beer is made by sprouting the grain, usually barley, drying it with heat-toasting to stop growth, cracking or grinding it, soaking in hot water to get out the sugars, cooling and adding yeasts to carry out the fermentation.

Once people were able to produce alcoholic beverages at will, a problem developed in the industry. Unless the beverage was consumed rather rapidly, it became sour and was no longer pleasant to drink. The beverage had turned into vinegar. The alcohol that had been produced by the yeasts was, in turn, being converted to acetic acid by bacteria of the Genus *Acetobacter.* This was to remain a problem for the beer and wine industries until the 1860's, when Louis Pasteur utilized heat

(Pasteurization) to destroy the spoilage organisms.

One may prepare vinegar by adding *Acetobacter* microbes to a bottle of wine or beer, or by just leaving the bottle open for the microorganisms to enter by chance.

Meanwhile, in the Far East, some unusual fermentations were being developed which, for the most part, have not entered the diet of the West, except for soy sauce or shoyu.

Tempeh is prepared from soy beans which have been soaked for about twelve hours; the seedcoats removed; the beans boiled for about ½ hour; then cooled, and inoculated with spores of the mold, *Rhizopus oligosporus,* or pieces from a previous cake. The beans are packed tightly into a container, covered and set aside for a day. When removed, the beans should be bound together by a mass of white mold. This may be sliced, salted and fried. The above procedure was developed because soybeans are difficult to digest but, after fermentation, they were easily digestible.

To flavor the Tempeh, soy sauce or Shoyu was developed. Actually, both were probably made in antiquity from other types of beans because the soy bean (*Glycine max*) was not widespread until after the 2nd Century, B.C.

Shoyu: the beans are cooked; mashed; and strained. The "milk" is then boiled and curdled to deposit a curd which is formed into the bean-cake, Tofu. The mashed bean that was left, is shaped into cakes and put in a cool place to ferment for several months. The moldy coating which covers the cake is scraped off and the cake is soaked in brine for several weeks. The salty liquid which results is soy sauce or Shoyu. The remaining cake is a flavorful "cheese". The mold usually isolated from the fermentaion is *Aspergillus oryzae* or *A. soyae*. However, others could be present. *A. flavus* produces aflatoxins which are highly toxic and carcinogenic and could be present in the fermentation. This fungus has been partially blamed for the high incidence of stomach cancer in Asia.

To end this introductory portion, the following is a list of many of the fermented foods and beverages of the world and the micoorganisms involved in the process, if known. The fermentation process often results in a change in the texture of the food; a change in the flavor; may enhance digestibility; may preserve the food; may change the color; make it more appetizing; may increase the vitamin content; may change the physical state of the food; may, due to the production of alcohol, have a physiological effect on the consumer.