Part I

Introduction, Scope and Importance of Wine and Brandy
Wine and Brandy: A Perspective

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1. INTRODUCTION

Wine is regarded as a gift from God and has also been described as a divine fluid in Indian mythology. Its early history is associated with romance. It has been prepared and consumed by man since antiquity. The aesthetic postures of wine can be gauged by the quotations like ‘wine is the most healthful and the most hygienic beverage (Louis Pasteur)’, ‘wine is a chemical symphony (Amerine), ‘wine is a bottled poetry’ (Stevenson) or ‘wine is a food’ (Oliver Wendere Holmas). The Codex Alimentarius commission defines, “Food as any substance whether processed, semi-processed or raw which is intended for human consumption, and includes drink”. Throughout millennia, wine, more than most foods, has captured imagination of poets and philosophers. More recently, it has captured the imagination of scientist, and various agri-food industries. It has been espoused for centuries as a superior beverage.

On wine, Plato remarked, “Nothing more excellent nor more valuable than wine was ever granted to mankind by God”. Wines, referred to as ‘Soma’ in our ancient scriptures have been used as a medicine. Rigvedas have also mentioned the medicinal power of wine.

The origin of wine might be accidental when the juice of some fruit must have transformed itself into such a beverage having exhilarating or stimulating properties. Clearly, the first wine-master must have been a caveman who discovered the magic of fermentation. When the man became civilized, wine and brandy were at the top of his list of requirements. The consumption induced euphoria and pleasing relaxation from the strains of life, so it eventually gained social importance and had been used for religious feasting and celebration as well as for entertaining guests. Consumption of wine in real sense is a form of returning to nature and escape from the social bonds. For the ancient man, the result of grape fermentation was the transformation of perishable seasonally available fruit into relatively non-perishable beverage with novel and potentially intoxicating properties. Today, wine is an integral component of the cultures of many countries.
Wine is a completely or partially fermented juice of the grapes (Plate 1.1), but fruits other than grapes like apple, plum, peach, pear, berries, strawberry cherries, currants, apricot etc. have also been utilized for the production of wines.\textsuperscript{5,7,8,25,98,101,109,169,110,111,117,138} After wine from grapes, cider and perry occupy the place in production and consumption of wines. Another grape product is brandy made by distillation of wine. The word ‘brandy’ is a Dutch word ‘brandewijn’ which means burnt wine while \textit{al-koh’l} is an Arabic word.\textsuperscript{26} Going by composition of grape, the type of sugar stored (soluble sugars) suitable for fermentation by yeast into alcohol, amount of acid present in the berries to limit the growth of most spoilage causing bacteria and fungus,\textsuperscript{102} the fruit is considered most suitable for wine production. Similar to wine, brandies from other fruits like plum, peach, pear and apple are also prepared.\textsuperscript{8,76,109} About wine, King Solomon said, “A little wine makes the heart glad, while St. Paul advised Timothy, “Take a little wine instead of water for your frequent infirmities”. These statements have now been proved as a sound advice. The perception that wine is good for body is now scientifically supported and there is no dispute that moderate wine consumption is associated with lower mortality from coronary heart diseases.\textsuperscript{45,194} The complex chemistry of wine composition is familiar to wine consumers who can wax lyrical about resveratrol and anthocyanins.\textsuperscript{28} The healthful benefits of wine are now largely attributed to the antimicrobial activities of ethanol, and antioxidant properties of phenolic components and flavonoids.\textsuperscript{148} Besides, these are nutritious, safer and provide psychotropic effects and are preferable to distilled liquors.\textsuperscript{64,103} Wine is an important adjunct to the human diet so as to increase satisfaction and contributing to the relaxation necessary for proper digestion and absorption of food. Glucose tolerance factor (GTF) - a chromium containing compound which is synthesized by the yeast is considered beneficial in cure of diabetes, is also found in wine.\textsuperscript{169} The brandy also have antioxidant activity and has been found to increase during aging in barrels.\textsuperscript{29} It may, however, be admitted that the contrasting social and antisocial effects of moderate versus excessive alcohol consumption must have become evident as soon as wine was discovered.\textsuperscript{102} Scientific research has also documented that excessive alcohol consumption, both acute and chronic, can have devastating effects on the physical and mental well being of the consumers. Consequences of excessive consumption of alcohol can be cirrhosis of the liver, enhancement of chances of hypertension, strokes and development of breast and digestive tract cancers.\textsuperscript{172} Nevertheless, moderate wine drinkers are less likely to demonstrate those alcohol related problems that have given alcohol a bad reputation.\textsuperscript{181} Certainly, wine has higher social image than other beverages containing alcohol. Generally, there is no accepted system of classification of wines,\textsuperscript{102,103} though, these may be classified broadly according to colour as red, rosé (pink) or white or could be differentiated as table, sparkling or fortified wines. Table wines may be red, rosé, or white. There are specific varieties for wine or more precisely for red and white wine making.\textsuperscript{8} The alcohol content of table wine is generally 10-11 per cent, while that of cider and perry are usually 2-8 per cent. Fortified or dessert wines contain added brandy and could be red or white, with alcoholic content ranging from about 16 to 23 per cent. Such wines with additional flavouring are called aromatic wines like vermouth. Sweet wines are high in sugar content while dry wines have negligible amount of sugar. Wine classification may be based on the
Wine and Brandy: A Perspective

geographic origin, grape variety used, method of fermentation, maturation process or may bear generic names. For detailed information, the readers are referred to a separate chapter of this text and the literature cited.\textsuperscript{107,183}

Wine production is both an art and science rather a blend of individual creativity and innovative technology. At the same time, it is a business with economic factors attached with it. It may, however, be admitted that wine making has developed from a haphazard, ill understood and risky process into a well defined process. \textit{Saccharomyces cerevisiae} is the microorganism on which the whole gamut of wine and brandy preparation rests, wherein fermentation of sugar into carbon dioxide and ethyl alcohol is initiated.

The leading wine-producing countries include France, Italy, Spain, Argentina, Portugal, Germany, South Africa, and the United States. Cider and perry are important products in England and northern France; fortified cherry and black currant wines are produced in Denmark; and important American fruit wines, produced mainly on the eastern coast, include apple, cherry, blackberry, elderberry, and loganberry wines. In India, wine production is negligible but is picking up.\textsuperscript{113} Brandy is prepared (Plate 1.2) and is consumed as a medicine in the extreme cold regions of the country. Production of wines assumes great significance from the fact that fruits are highly perishable commodities and have to be either consumed immediately or preserved.\textsuperscript{190} The increased production can be soaked profitably, if fruit wine and brandy production is taken up. Setting up of such units besides industrialization of the fruit growing belts, could result into economic upliftment of the orchardists’ generation of employment opportunities and better returns of their produce.\textsuperscript{181}

2. ENOLOGY – A SCIENCE OF WINE MAKING

The wine is a food, as described earlier. No other food has contributed to mainstreaming the appreciation of agro-biodiversity, sensory sciences, and even food chemistry, as much as wine.\textsuperscript{28} The reverse is also true, as several sciences have contributed to our knowledge of wine. The process of wine making is very unique in the sense that nearly all the physical, biological especially microbiological and chemical sciences and engineering are involved, and in the past have contributed immensely to the scientific elucidation of ‘enology’ the science of wine. Enology can, thus, be defined as the science of wine making, comprising the horticultural, biological and food science, technological and engineering inputs of the process besides economics and marketing aspects. In real sense, it is a combination of several aspects of knowledge and is an interdisciplinary subject. Principles of chemistry, microbiology, food science, biochemistry, genetic engineering, chemical engineering, nutrition, economics and marketing and sensory science are the pillars on which the enology rests (Fig. 1). Therefore, it is essential that a successful enologist possesses in-depth knowledge of these aspects, makes wine of superior quality and market it too to bring profit to the wine industry.
3. ORIGIN OF VINE AND WINE

3.1 Origin of vine and spread of viticulture

Plant taxonomists consider the region between the Black and Caspian seas to be the original home of the Old World grape. Grape culture first began in Asia Minor from where it spread to both West and the East. It was under way in the Near East as early as the 4th millennium BC. In 1612, grapes were introduced to the Eastern coast of the United States. Before 600 BC, the Phoenicians probably, carried wine varieties to Greece, then to Rome and to Southern France. Fossil vines which are 60 million years old, are the earliest scientific evidence of existence of grapes. The earliest documentation of viticulture is in the Old Testament of the Bible. *Vitis vinifera* was being cultivated in the Middle East by 4000 BC, and probably earlier also. Egyptian records dating from 2500 BC refer to the use of grapes for wine making. The vine was evident in 6000 BC in Egypt, 3000 BC in Pheonesia and 2000 BC in Greece and in China. Starting about 1000 BC, the Romans made major contributions in classifying grape varieties and observing colour and charting ripening characteristics, identifying diseases and recognizing soil type preferences. Skills of pruning and increasing yields through irrigation and fertilization were also acquired by the Romans.

The Greeks introduced viticulture in France, North Africa and Egypt while Romans exported the vines to Bordeaux, the valleys of Rhone, Marne, Seine etc. and to Hungary, Germany, England, Italy and Spain. The trade between France and England flourished after the marriage of king Henry of England with Eleanor of Equitaine who brought along with her as dowery, the provinces of Bordeaux and Gascony of France. The Greeks also planted grapes in their colonies from the Black Sea to Spain. Following the voyages of Columbus, grape culture and wine making were transported from the Old to the New World. Spanish missionaries took viticulture to Chile and Argentina in the mid-16th and to lower California in the 18th century. The prime wine-growing regions of South America however, were established in the foothills of the Andes Mountains. The centre of viticulture however, shifted to California from the southern missions to the Central Valley and Sonoma, Napa, and Mendocino. British settlers
planted European vines in Australia and New Zealand in the early 19th century, while Dutch settlers took grapes from the Rhine region to South Africa as early as 1654. The cultivation of vine was important and used to be emphasized as is revealed by the Treatise in Cato, as... “If you ask me what sort of farm is best, I will say this, one hunderd jugera of land consisting of every kind of cultivation field and in the best situation; the vineyard is the first important if the wine is good and the yield is great”. The most comprehensive account of Roman viticulture is found in 12 books of the *de Re Rustica of Lucius Moderatus* by Columella (1941, 1954, 1955), where account of vineyard layout has been described. Readers are referred to the literature cited for more details on these aspects.11,102,189,198

Evidence of existence of grape farming in India has also been documented. The ancient Aryans possessed the knowledge of grape culture as well as beverage preparation from it.177 Grapes were known in India since 11th century B.C. Famous Indian scholars, Sasruta and Charaka in their medical treatise entitled, *Sassuta Samhita* and *Charaka Samhita*, respectively, written during 1356-1220 B.C., mentioned the medicinal properties of grapes. Kautilya in his ‘Arthashastra’ written in the 4th century B.C. also referred to the type of land suitable for grape cultivation. Native spp. resembling *Vitis lanata* and *Vitis palmata* grow wild in the north western Himalayan foot hills. Indigenous varieties known as ‘Rangspay’ ‘Chholtu white’ and ‘Chholtu Red’ are grown in Himachal Pradesh (India) even today.178 Persian invaders in 1300 A.D. are believed to have introduced grapes into North India from where they were introduced into the Sough (Daulatabad in Aurangabad district of Maharashtra) during the historic event of changing the capital from Delhi to Daultabad by king Mohammed-bin-Tughlak. A Moorish traveller, named Ibu Bahuta, who visited Daulatabad in 1430 A.D. is said to have seen flourishing vineyards in South India. Grape was introduced into Salem and Madurai districts of Tamil Nadu in South India, by Christian missionaries around 1832 A.D. and into Hyderabad province by HEH, the Nizam of Hyderabad in the early part of 20th century.

### 3.2 Origin of wine

The existence of alcoholic beverages like wine in ancient time, has amply been proved by paintings, articles, writings of historic themes in different parts of the world. Most of the civilizations had their characteristic wine or other alcoholic beverages had myths about the origin of wine making and attributed its discovery to divine *revelation*. But the beginning of the art of wine making was shrouded in prehistoric darkness. There is evidence to suggest that process of wine making existed long even before the chronicles found in Egyptian hieroglyphics (Plate 1.3). In the very first chapter of the old testament, it has been described how Noah landed his ark on Mount Arart and promptly planted a vineyard in order to make wine.191 It is also certain that wine drinking had started by about 4000 BC and possibly as early as 6000 BC. The texts from tombs in ancient Egypt, amply prove that the wine was in use around 2700 to 2500 BC when priests and royalty were using it. Archeological excavations have also uncovered many sites with sunken jars (Plate 1.4) indicating the existence of wine for more than 7.5 thousand years.145 Evidence of wine making first appeared in the representations of wine presses (Fig. 2) that date back to the reign of Udimu in Egypt, some 5000 years ago.156 The hypothesis of the Near Eastern origin and spread of wine making, is also supported by the remarkable similarity between the words meaning wine in most Indo-European languages.163 Besides this, most eastern Mediterranean myths
located the origin of wine making in north eastern Asia Minor.\textsuperscript{185} The Pheonicians from Labanon, introduced the wine and its secrets to the Romans and Greeks, who subsequently, propagated the art of wine making.

![Fig. 2. A diagrammatic view of a wine press (Heiroglyphics of SHEMW, god of wine press). Source: Ref. No. 73.](image)

In Greece, one of the most famous wines was the Pramnian wine mentioned by Homer in the Iliael. The sweet wines appeared to be made from dried grapes in a manner similar to that described by Hesoid in \textit{De Materica Medica of Dioscorides} in 1934. ‘Omphacites’ was the wine produced in the island of Lesbos from the sun-dried grapes while ‘Cos wine’ was reputed to be sour, and wines of ‘Chios’ were heavily resinated.\textsuperscript{201} Typically, the Greeks added a wide range of flavouring and diluting substances to their wines, including sea water, spices, honey and raisin. ‘Cumae’ near Nepale was founded about 750 B.C. Syracuse in Sicily in 734 B.C., Sybaris and Crotona in Southern Italy etc. were well established and their inhabitant were well versed in the art of wine making.\textsuperscript{36,43}

Wine came to Europe with the spread of the Greek civilization around 1600 BC. Homer’s Odyssey and Iliad both contain excellent and detailed descriptions of wine. It was an important article of Greek commerce and Greek doctors, including Hippocrates, were among the first to prescribe it. Romans were highly developed in the technology of wine making but lacked in the preparation of medicinal wines and method of wine preservation. The export of Italian wine to Gaul in exchange for slaves was also in practice.

### 3.3 The origin of wine yeast
The main concept of wine fermentation came at the end of 17th century when Van Leuwenhoek described the occurrence of yeasts in grape musts and beer worts. The first scientific work on fermentation was published by Lavoisier and in 1936 Cagmard-Latoor proved the role of yeasts as living organisms which cause biochemical transformations, as summarized earlier.\textsuperscript{76,111} The wine yeast (\textit{Saccharomyces cerevisiae}) apparently is not an indigenous member of the grape skin-flora, the natural habitat of the ancestral strains of \textit{S. cerevisiae} (Plate 1.5) may be the bark and sap exudates of oak trees.\textsuperscript{157}
3.4 Origin of barrels and chips
The Fig. 3 depicts the three major events in the history of man and the origin of barrels is one of these events. Origin of barrels dates back to the pre-historic era of wine.\textsuperscript{47}

![Image of wheel, barrel, and silicone bung]

Fig. 3. Depiction of some of the important events in the history of man.

When wine was first prepared in the beginning man, woman and child were the farmers, the question of its storage came up. On the farms, there were pigs for whom woman and child found many uses and one of the use was to hold wine into the pigskin. Possible events in the origin and use of oak barrels,\textsuperscript{47} might have been like this:

- Use of pigskin could have been made to store the wine, but it might have started expanding resulting in difficulty in carrying out the wine. The child might have dropped the wine, consequently lost it.

- Use of clay pots might have been started by the farmers by taking wet clay and making pots of it followed by drying upon fire. In next season, pots could have been used to store wine. But, because of more weight after filling them with wine, child might have again failed to carry the pot and got broken, and might have lost the wine.

- Use of oak wood could have been made by drying upon fire, it might have got warped and then, oak barrels might have originated. Consequently, the wine could be carried for storage into caves, successfully.

By this, origin of barrels took place and practice of storing wine into oak barrels came into existence. It was a great invention which not only helped the farmers to store the wine but also increased their profits many times. With this, wine makers also started demanding oak flavoured wines. The farmers could easily carry the barrels anywhere and it made the wine making quite practical.

3.5 Origin of distillation
Wine was distilled and the distillate of wine was called a ‘Wine spirit’. The Arabians developed an apparatus called \textit{alambic} and the world “alcohol” was referred to the distillate from the \textit{alambic}.\textsuperscript{115} The approximate time of origin of some other distilled alcoholic beverages is given in Table 1. One of the
distillation apparatuses used for this purpose is shown in Plate 1.6. More details can be had from the literature cited.\textsuperscript{153,200}

<table>
<thead>
<tr>
<th>Beverages</th>
<th>Time</th>
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<tbody>
<tr>
<td>Sautchoo in China</td>
<td>Before Christian Era.</td>
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<tr>
<td>Arrak in India</td>
<td>800 B.C.</td>
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<tr>
<td>Mead in Britain</td>
<td>500 A.D.</td>
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<tr>
<td>Brandy in Germany</td>
<td>1100 B.C.</td>
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<tr>
<td>Brandy in Italy</td>
<td>1000 A.D.</td>
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<tr>
<td>Cognac in France</td>
<td>1300 A.D.</td>
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### 4. HISTORY OF WINE

#### 4.1 Salient features of history of wine

Salient features of history of wine are summarized in the following Table 2.

#### 4.2 Evidence of wine and brandy

Indirect evidences about the existence of wine, its consumption and production technology have come out from different sources such as paintings, engravings on the buildings, writings of poets, mythological evidences, religious commands or writings from such books, and records of export and import of wines, and consumption of wine.\textsuperscript{15,17} In the crypts of Pyramids, numerous grapes have been found.\textsuperscript{191} The Periplus of Erythralan Sea written in 1912 towards the end of first century A.D., noted that the wine was produced in the Southern Arabia, particularly in the vicinity of Muza, modern AlMukhya. The oldest bottle of wine which is approximately 325 BC old was found in 1867 in excavation work in a vineyard near the town of Speyer, Germany (Plate 1.7). Besides the bottles, the Romans also developed wooden cooperage for wine storage. Wine amphoras may also have been employed to store on their sides or upside down, thus keeping the cork wet with wine.\textsuperscript{2,77,125} Amphoras, cork-sealed and containing wine remnants, have been excavated on several occasions from Mediterranean (Plate 1.4).\textsuperscript{37,70} Queen Nefertiti is reported to have used wine as a base for her perfume.\textsuperscript{191} Ancient relics of wine growing are proudly displayed at the wine museum in Beoune, the capital city of Burgandy in France. In the North of Beaune is the famous Clos de Vougeot, established during the mid-1300s by the monks of Citeaux where much of the winery remains are intact. In Germany, a few miles west of Wiesbaden near Rhine, one can see magnificent Kloster Ebebach which was used for making wine.\textsuperscript{191}

#### 4.3 History of Alcoholic Fermentation

Historical developments in microbiology and biochemistry of alcoholic fermentation paralleled the development in wine fermentation. Jean Baptise Van Helmont (1577-1644) explained some of the concepts of fermentation and the chemistry involved in it. Antoine Lavoisier (1743-1794) restored the term
Wine and Brandy: A Perspective

Table 2. Salient features in the History of wine.

- The Romans organised the grape and wine production and during the era taste of wine was developed
- Muslims destroyed the wine industry of the country, they conquered
- The need for wine for the religious ceremonies led to the development of wine in Central Europe
- After the collapse of Western Roman Empire in the 5th century AD, the survival of viticulture depended upon the symbolic role that the wine played in Christianity
- In the Western Europe, vineyards were developed
- Earlier colonial fermented beverages were from sugar-rich fruits and vegetables
- The more aristocratic colonists preferred imported wines
- The trend of wine consumption shifted towards the distilled beverages in 18th century after the discovery of distillation
- By 17th Century, the coopers built more and better casks and barrels for longer and safe aging of wine
- Introduction of corks led to the survival of bottled wines for longer period
- By the 19th century, the scientific work of Pasteur, revolutionised the wine industry with recognising the roles of yeasts and bacteria
- In the 1960’s, mechanization (grape harvesters and field crushers) in the vineyards contributed to better quality control
- The Greeks stored wine in earthenware amphorae, and the Romans extended the life of their wines with improved oak cooperage
- Both Greece and Roman civilizations drank almost all of their wines within a year of vintage and disguised spoilage by adding flavouring agents
- Wooden barrels remained the principal aging vessels until the 17th century, when mass production of glass bottles and the invention of the cork stopper allowed wines to be aged for years in bottles
- Pasteur also identified the bacteria that spoil wine and devised a heating method (called pasteurization) to kill the bacteria
- Advances in plant physiology and plant pathology also led to better vine training and less mildew damage to grapes
- Stainless steel fermentation and storage tanks as could be easily cleaned and refrigerated to precise temperatures, improved the quality of wine
- Automated, enclosed racking and filtration systems reduced the contact with bacteria in the air thereby preventing spoilage

Source: Ref. No. 61, 189.

‘Alcohol’ and quantitatively determined the amount of carbon dioxide and ethanol produced during fermentation of grape juice and gave the equation of ethanolic fermentation.\(^{13}\)

The ‘Father of Microbiology’ Leuwenhoek in 1680 had observed yeast cells with his ground lens, for the first time, in the fermenting beer. Schwann in 1937 recognised it as a fungus and gave the name ‘Zuckerpilz’ (sugar fungus). It was perpetuated in the generic term Saccharomyces.\(^{130}\) In the fermentation research, most significant contributor has been Louis Pasteur (Plate 1.8) who demonstrated clearly
Fig. 4. A diagrammatic view of various discoveries associated with fermentation.
during 1855 to 1876 that the fermentation was a physiological action associated with life processes of yeast.\textsuperscript{34,155}

Later on, the substances responsible for fermentation were named as ‘Enzymes’ which means ‘in yeast’ coined by Wilhein Kuhne in 1878 and it was in 1897 that Buchner obtained an enzyme from cell free juice from yeasts that was not capable of fermentation.\textsuperscript{85} Neither the filtrate nor the residue from the yeast cell dialysis was capable of fermenting glucose. On combination of the two, the fermentation took place indicating that fermentation required the presence of other substance ‘Coenzyme’ which was dialyzable and thermostable. It is quite apparent that the study of biochemistry and biochemical reactions has evolved from research on yeast and alcoholic fermentation.\textsuperscript{58,126,167} The chronicle details of history of fermentation are depicted in Fig. 4. For more information, the readers are referred to the literature cited\textsuperscript{132} and a chapter on biochemical aspects of wine fermentation of this text.

### 4.4 Use of barrels in the wine industry

The use of oak barrels for storage of wine is one of the most important event in the history of wine. A summary of various events using barrel in wine industry has been made in Table 3.

#### Table 3. Some historical events in use of barrels in wine industry.

- 1979: Vincent Bouchard - a trained Enologist started selling barrels in USA and around the world
- 1980: Creation of the first silicone bung by Vincent Bouchard
- 1984: Vincent Bouchard demonstrated that forest origin had a much greater influence on the wine
- 1985: Vincent Bouchard was the first to use plastic wrap to protect the barrels from damage during transport and from loosing humidity
- 1994: Vincent Bouchard did the first comparative tasting of French Bordeaux varietal wines aged in Hungarian and French oak barrels in the USA
- 1996: Direct application of Vincent’s charring theory was made after Vincent theorized that the more you toast or char the barrel, the less astringency is obtained together with a softer, creamy character in the distillate
- Equally significant was the development of an air bung which prevented the spoilage of wine from acetification (Plate 1.9)

### 4.5 History of Distilled Beverages

Evidences such as unearthing of a pottery in Mesopotamia where a fermentation scene is depicted dating back to 4200 B.C. have shown the production of distilled spirit in ancient times. Aristotle has mentioned about a wine from which a spirit was produced. However, Greek-Egyptian alchemists of 1st or 2nd century AD are accredited with 1st distillation who might have distilled wine in attempting to transmute base metal into gold. Arabians gained the knowledge of distillation from Egyptian, and passed on to the Western Europe through Spain about 1150 AD. The distilled spirit was called as *aqua vitae* e.g. ‘Water of life’.
In Europe, the distillation was known at least by the 11th or 12th century. In 16th and 17th centuries, the art of distillation was well spread and distilled spirits became popular and a full scale industry. Indians had also fermented drinks from maple syrup, corn and chestnut. The early methods of distillation was alambic distillation followed by development of stills made up of clay or brick fire boxes with copper pot. In these distillation systems, direct heat was applied and later efforts were directed to develop better distillation apparatuses in France mostly to make brandy in 18th century. The pre-heater was invented in 1801 by Aragand and Adam. In 19th century, several distillation stills were patented in France and England.

4.6 Wine Mission for California

California’s first documented imported European vines were planted in Los Angeles in 1833 by Jean-Louis Vignes. During 1850s and ’60s, Agoston Haraszthy, a Hungarian soldier, merchant and promoter, imported grape cuttings from the greatest European vineyards to California and is rightly called as the Founder of the California Wine Industry. Unfortunately, Haraszth’s success was almost negated by the vine root louse *Phylloxera vastatrix* (Fig. 5) which was discovered in England in 1863. This louse attacked and fed on the vine roots and leaves. *Phylloxera* is indigenous to the Mississippi River Valley but was unknown outside North America at that time. Native American varieties developed resistance to *Phylloxera* by evolving a thick and tough root bark, thus were relatively immune to the damage. However, the *V. vinifera* vines had no such evolutionary protection, so *Phylloxera* ate away their roots, causing them to rot and the plant to die. By 1865, *Phylloxera* had spread to vines and over the next 20 years, it inhabited and decimated nearly all the vineyards of Europe. By grafting of every vine in Europe over to American rootstocks was undertaken and thus, the European wine industry could be retrieved from extinction. During the period when the Europeans were contending with *Phylloxera*, the American wine industry was ironically flourishing. By 1900, a fully developed and proud commercial wine producing business was established in America.

![Phylloxera vastatrix - vine root louse](Ref. No. 183)
4.7 New alcoholic beverages

4.7.1 Vermouth
By the 15th century, based upon the property of alcohol to act as a solvent for a number of essences of fruit, spices and herbs, a number of drinks were prepared. Benedictino was created by addition of 27 herbs in the wine distillate in 1510 while Chartreuse was made from brandy having 127 herbs.\(^{175}\) During 17th century, alcoholic beverages like *aperitifs* or vermouth emerged. In Italy, drinks like rosoglio or rossoli were made during medieval times.\(^{26,67}\) For more information on vermouth, literature cited may be consulted.\(^{158,159}\)

4.7.2 Champagne
The sparkling nature of wines had certainly been established by 1676, when Sir George Etheridge mentioned ‘Sparkling Champagne’ in one of his play and the sparkling wine became very popular in France. For more historical aspects, see the literature cited.\(^{63,180}\) It was also discovered that bottled wines develop effervescence after several months in the bottle leading to preparation of a new wine called sparkling wine. Though the popularity of wines grew more but the guarantee of success of secondary fermentation got ensured through the use of stronger bottles and better fitting bottle corks.\(^{31,32}\) But, addition of sugar before bottling greatly increased the amount of sparkle in such wines, leading to the widespread production of adulterated sparkling wine.\(^{189}\) Technological aspects of production of sparkling wine form the subject matter of a separate chapter of this book.

4.7.3 Sherry
The addition of cooked wines to the wines meant for export in Spain, made the wine sweet due to evaporation by cooking and prevented their spoilage. Such wines were named as *Sherris-sack* or presently known as sherry. The yeast developed after secondary fermentation on the surface of wine called ‘flor’, also helped in preventing the deterioration especially from acetic acid bacteria. The alcohol contents these wines range from 13.5 to 17.5%.\(^{38,69}\)

4.7.4 Fortified wines
Addition of brandy prior to the completion of fermentation made sweeter and stronger wines suitable to the taste of the English, called fortified wines. Since brandy and wine took time to blend, the young wines remained unpleasant but became mellow after blending and storage, hence started the practice of aging or maturation. By 1775, elongated bottles with short necks were developed which could be kept on their sides enabling the wine to stay in contact with the cork.\(^4\) (Refer to a separate chapter of this book on fortified wines for more details).

4.7.5 Port
Port—a type of fortified wine was a new wine created at the end of 17th century and was named after the town ‘Porto” in Portuguese (Plate 1.10). Its development to some extent was related with the use of bottles and its longevity could be traced to the high alcohol content found in the wine.\(^{24,39,91,173,179}\)
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