1.0 DEFINITIONS

**Wines**
Alcoholic beverages manufactured by alcoholic fermentation of fruit musts or fruit juices. Generally refers to beverages produced from grapes (*Vitis* spp., mainly *V. vinifera*).

**Fruit wines**
Wines fermented from many other fruits e.g., apples, berries, peaches, and even herbs. They are made from musts or juices of other fruits. The term wines may also be used to refer to rice wines (made from saccharified rice mashes), and palm wines (made from palm sap) from palm trees.

**Sparkling wines**
Wines which contain sufficient dissolved carbon dioxide to result in effervescence when the bottle is opened. The high carbon dioxide content may be achieved by secondary fermentation (in the bottle or in a tank) or by a carbonation process.

**Sparkling winemaking**
Processes involved in manufacture of sparkling wines.

**Dessert wines**
Sweet wines of varying alcohol content usually drunk in small amounts as an accompaniment to the dessert course of a meal. May also refer to fortified wines.

**Fortified wines**
Wines to which ethanol has been added, as spirits or neutral alcohol. Important types include sherry and port.

**Champagne**
Sparkling wines made by the **Methodé Champenoise** in-bottle secondary fermentation process, in a defined area of northeast France.

**Champagnization**
The specific **winemaking** process used for manufacture of **champagne**, involving in-bottle secondary fermentation under defined conditions.

**Cider**
In the UK, alcoholic beverages made by fermentation of apple **musts**.
In the USA, this alcoholic beverage is termed hard cider, and the term cider refers to unfermented apple **juices**.

**Wine coolers**
Beverages made by blending wines with other ingredients, including water, fruit juices, sugar, flavourings and ice.

**Wine distillates**
Intermediate products or finished **spirits** made by **distillation** of wines.

**Winemaking**
Process of manufacture of **wines**. The basic process comprises crushing **grapes**, alcoholic fermentation of the **grape juices** and ageing of the wines. Many additional processes may be applied, including maceration, clarification, chaptalization (addition of sugar to grape **musts** to increase alcohol content in the resulting **wines**). Legal in some **winemaking** countries, prohibited in others. **Filtration**, **fining** and, in the case of **sparkling wines**, secondary fermentation.

**Wineries**
Industrial establishments where **wines** are manufactured.

**Wines manufacture**
Alternative term for **winemaking**.

**Winemaking grapes**
Grape cultivars used primarily for **winemaking**, which also have the characteristics that also make them especially suitable for this application. Mainly **Vitis vinifera**, but other **Vitis** spp. or their hybrids with **V. riparia** are also used for winemaking. The quality of grape is affected by the variety of the grape soil conditions and climate. A year with a good climatic conditions is known as a **vintage** year.

**Wine vinegar**
**Vinagar** produced by **acetic fermentation** of **wines**, e.g. **red wines**, **white wines** or **sherry**. Wine vinegar has a wine-like **flavour** and is used more as a flavouring than as a condiment, e.g. as an ingredient of **salad dressings**. **Wine yeasts** Yeasts used for fermentation of grape **musts** to produce **wines**. May be spontaneously occurring yeasts, or pure yeasts cultures. Mainly
Succharomyces spp., although other genera of yeasts may play a role in the early stages of fermentation.

Must

Dessert wines

Sweet wines of varying alcohol content usually drunk in small amounts as an accompaniment to the dessert course of a meal. May also refer to fortified wines.

Fortified wines

Wines to which ethanol has been added, as spirits or neutral alcohol. Important types include sherry and port.

Grape marc

By-products from wineries, comprising the pomaces remaining after grapes have been pressed and the musts separated.

Desulfitation

Removal of salts of sulfurous acid, usually sulfites, and SO₂. Wines for distillation can be desulfited using CaCO₃. Musts that are preserved by heavy sulfitation, and used for adjustment of sweetness of wines, require desulfitation before use. In the Brimstone winemaking system, clarified grape juices for wine making are preserved with high levels of SO₂ (1200-2000 mg/l) and then desulfited just before fermentation.

2.0 WINE MAKING

Wine are made by the conversion of sugar in grapes or other fruits into alcohol. The maximum sugar accumulated in grapes during ripening before harvest depends on the variety of grape and the climate of the region where it is grown. For most varieties sugar concentrations of 15–25% is reached but late harvest fruits may have 30–40% sugar. The eventual alcohol content of the finished wine product depends on not only the sugar content but also on the completeness of the fermentation. In the case of dessert wines (fortified wines), the amount of alcohol added during or after fermentation. At least 9% alcohol (by volume) is needed to prevent rapid spoilage by acetification of the finished product. When the sugar content is low in the grapes of fruits, it becomes difficult to attain this level of alcohol (1% sugar yields 0.55% alcohol according to the fermentation formula), sugar or grape concentrate may be added. The process called Chaptalization is normal in cool-climate regions e.g. Eastern USA, Germany, France etc, but it is prohibited in other areas e.g. California, Spain, Italy.
The basic principle of brewing wine is same for brewing alcoholic beverages like beer. The sugar source is converted to alcohol by the action of a culture of *Saccharomyces cerevisiae*. However, the source of sugar is the fruit of *Vitis vinifera*, the grape vine. The distinctive character of various wines and fruit wines depend on the composition of the raw material, the nature of the fermentation process and processing and ageing treatments. Primarily one molecule of glucose or fructose is converted to 2 molecules of ethanol and 2 molecules of CO₂ by the metabolic system of the yeast. However, other by-products of the yeast activity is released into the system.

Wines are produced in many different ways. In general, grapes are washed, removed from the stem, crushed and the juice which is also called must is collected. The must is transferred into tanks also known as vats and stored there. Fermentation may also take place in the vats. Wine makers would traditionally allow the natural yeast flora of the grapes to ferment the batch of grape juice also called “Must”, and some still practice this method. A variety of yeasts colonize grape skins with *Kloeckera* and *Hanseniaspora* being the most prevalent and of *Saccharomyces* present in very low numbers. In contrast, the surfaces of winery equipment generally harbour a yeast flora in which of *Saccharomyces* predominates and these may be the major source of this species. Alternatively, for the must to be fermented it can be inoculated with a **Starter Culture** (microbial cultures used to initiate fermentation) which can be in a slurry form, as freeze dried (lyophilized) wine yeast or pressed yeast is common and desirable to initiate the fermentation. Numerous strains of yeast for wine making are available from dealers. To prevent growth of undesirable microorganisms 25 – 100 mg/L (ppm) sulfur dioxide (in the form of potassium metabisulfite) is added to the must about 2 hours before the yeast. SO₂ acts as a selective antiseptic for bacteria and wild yeasts and permits the more rapid growth of added yeast. It also stabilizes wine colour. The must can also be sterilized by heating (blanching/pasteurization) followed by cooling.

Just as in beer making the initial stages of wine fermentation is allowed to proceed acrobically in order to develop a sufficient yeast cell mass or population that will sustain and perform the main fermentation but under anaerobic conditions in order to optimize the ethanol yield.

The strain of yeast *Saccharomyces cerevisiae* var. *ellipsoides* is used to produce wine. Commercially the most preferred are *Saccharomyces uvarum* and *S. pastorianus* both have a **greater ethanol tolerance** than the beer strains. This implies that the fermentation can proceed longer to produce higher ethanol concentrations of as much as 15% compared to about 8% for some beer types. The sugar in the must is converted to alcohol which is lower in density than H₂O hence the specific gravity or degree Brix (°B) is an approximate measure of the amount of sugar that has been fermented. Fermentation should be allowed to completion within the storage tanks 0.2% sugar. Usually 6 weeks after the grapes were crushed the fermentation is complete and perfectly dry.
To produce red wines the grapes are crushed with the skins and the must are fermented together during which the red colour are extracted. Anthocyanins are the pigments responsible for the characteristic red colour of red wine. They are fermented on the skins until maximum colour is extracted within 5 - 10 days. Red wine is typically fermented for 4 - 10 days at 25 - 30°C. In contrast white wines are produced by removal of the skin of the grapes and quickly separated to produce a pale coloured must which is also fermented in 4 - 10 days at 10 - 15°C. But the fermentation of white musts at a lower temperature may last several weeks. To produce a Rosé wine the must and skin are left in contact for a shorter period than for red wine. At the end of the fermentation, the flocculated yeast and any particles in the medium are allowed to settle to the bottom and the clarified wine is “racked off” into another container for the ageing process. The solid material now called the marc or pomace is transferred to the press. A basket press or Willies press in the larger wineries is often used for the filtration. The filtrate is fined by gelatin solution or egg white is added to combine with tannins and related compounds and precipitate. In order to remove excess potassium acid, tartaric wines are stored at low temperature of approximately -2°C. The clarified wines are bottled and stored in a cool place for ageing. Ageing could also be done in wooden (usually oak) vats for 3 - 6 months. The flavor improves during storage. During ageing, the bouquet (simply means the perfume of wine) and aroma of the wine are developed. Various compounds such as esters, are formed. Most wines are blended to form flavor consistency. As much as possible the wine must not make contact with air to avoid acetification. After ageing the wine may be pasteurized at 60°C for 30 min. to destroy surviving yeasts and microorganisms. Sterile filtration is another means of preserving wines. Sorbic acid may be added to wine as a preservative but not to sparkling wines because it produces the objectionable pineapple-celery colour. Wines are packaged in glass bottles or kegs for shipment. When properly aged wine is bottled it continues to improve for several years.

The production of sparkling wines like champagne goes through a process of secondary fermentation process. The wine is initially fermented as for any other wine. However, after the primary fermentation, the wine is transferred into thick-walled pressure-resistant bottles and closed with a small amount of yeast and sugar suspension and given a temporary cap. The closed wine is incubated at an incubated angle and the bottles are gently turned or “riddled” at frequent intervals so that the yeast cells settle towards the cap. When the champagne is judged to be ready, the neck is frozen to solidify the plug of yeast cells that has settled there. The cap is then gently tapped to release it and the pressure of CO₂ within the bottles ejects the plug. After this the bottle is corked and a wire cage applied over the cork to prevent its subsequent unintended ejection.

Table wines with excess CO₂ include white, pink, and red sparkling wines, with or without Muscat flavor (champagne, spumante, Sekt etc.). Non-sparkling white table wines are dry or sweet with regional, varietal and proprietary names (Riesling, Chardonnay, Chablis, Sauveteres, Merus etc.). Pink and red table wines are among the most important in terms of volume or consumer demand and have varietal, regional and proprietary names. There also numerous
dessert wines named after the grape variety from which they are made, the processes and the added flavours and herbs.

The special characteristics of wine yeast are:

1. Efficient conversion of grape sugar to alcohol
2. Rapid initiation of fermentation (within 48h)
3. SO\textsubscript{2} tolerance—important disinfection.
4. Ability to cause even fermentations.
5. Ability to ferment at low temperatures
6. Ability to ferment to dryness (alcohol tolerant)
7. Good flocculation after fermentation to aid in removal
8. Production of a desirable bouquet
9. Low foaming
10. Low H\textsubscript{2}S or mercaptan fermentation
11. For sensory quality of the wine, a relatively high glycerol production
12. Production of a relatively low amount of higher alcohols

All the listed characteristics cannot be found in one yeast strain but improvements can be made by mutagenesis, hybridization, cell fusion, transformation and genetic engineering. Wine makers are expected to carefully select strains that give them best results and continue to manage the quality of the yeasts by propagating new batches and discarding old batches.

3.0 DEFECTS IN WINE

Certain defects can occur in wine. The lower the sugar content, the less likely that spoilage is to occur. Thus dry wines are more stable than other types of wines. Spoilage is evident by flavor of odour changes as well as haze or gas formation. Alterations may be due to molds, lactic acid bacteria, acetic acid bacteria and chemical reactions.

To prevent microbial spoilage of the finished wine, it is important to deactivate any residual microorganism before or after bottling. This can be accomplished by pasteurization, addition of
inhibitors such as SO₂ or filtration. The delicate flavours of some wines are harmed by heating or adding SO₂. For wines, filtration is the preferred method of removing microorganisms.

Some microorganisms involved in wine spoilage are as follows:

Acetobacter

They are involved in the oxidation of ethanol to acetic acid. They are oxidize acetate and lactate to CO₂ and H₂O. They are found on fruits and vegetables and are involved in the souring of fruits and vegetables but cause the souring of alcoholic beverages, beer, and wine.

Glucosobacter

This genus is well represented by G. xylinus, which is capable of oxidizing ethanol to acetic acid. It causes spoilage of beer, wine, and cider.

Streptococcus

They can use sugar in an alcohol fermentation system and produce acid resulting in higher acid and lower alcohol. It causes ropiness in wines by production of dextrans.

Lacticobacillus mesenteroides

It produces dextrins in sweet wines which results in a ropy texture that becomes slimy and viscous.

Ascomycetes

Debaryomyces are film-forming yeasts that are associated with spoilt cider and white wines.

Schizosaccharomyces

As the name suggests it has a close relationship with Saccharomyces (meaning fermentation of glucose to alcohol). They are associated with wine spoilage.

Saccharomyces pombe

The yeasts converts malic acid to lactic acid acid resulting in a less acidic wine than when Saccharomyces cerevisiae is used.

Candida vini (formerly Mycoderma vini)

It forms “flowers” on wines and causes spoilage

Suggested Texts


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