Wine Production

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Wine

- Wine is an alcoholic beverage produced through the partial or total fermentation of grapes.
- Other fruits and plants, such as berries, apples, cherries, dandelions, elder-berries, palm, and rice can also be fermented.
- The species that are most widely used in wine production are *Vitis labrusca* and, especially, *Vitis vinifera*
- Wine grapes contain all the necessary ingredients for wine, including pulp, juice, and seeds that possess all the acids, sugars, tannins, minerals, and vitamins that are found in wine.
- As a natural process, the frosty-looking skin of the grape, called "bloom," catches the airborne yeast that ferment the juice of the grape into wine.
- The cultivation of wine grapes for the production of wine is called "viticulture.“
- Wine is characterized by color: white, pink or rose, and red, and it can range in alcohol content from 10 percent to 14 percent.

Wine

- Wine types can be divided into four broad categories:
  - table wines: include a range of red, white, and rose wines
  - sparkling wines: include champagne and other "bubbly" wines
  - fortified wines: are table wines with brandy or other alcohol added
  - aromatic wines: contain fruits, plants, and flowers
- Red wine is extracted from the skin of red grapes containing red pigment (anthocyanin).
- During the preparation of red wine, all the anthocyanin pigments are solubilized by the extract.
- Pink wine is obtained from either pink grapes or red grapes in which fermentation last for only 12 to 36 hour and only less amount of anthocyanin pigments are solubilized.
- White wine is prepared from the white grapes or from the red grapes in which pigment involved in colouring is removed.
- Wine production from crushed grapes is called enology.

Red wine	It has red pigments
White wine	It does not contain red pigments
Rose wine	It has less red pigments
Dry wine	It has more alcohol content
Sweet wine	It has more sugar content
Fortified wine	It is fortified with other alcoholic beverage
Sparkling wine	It has considerable amount of CO_2
Still wine	It does not contain carbon dioxide
Distilled wine	Brandy (alcohol content 21%)
Table wine	It has low alcohol and sugar content

Wine Making

- Wine making is something that has been done from thousands of years. Making wine is not just an art but there is also a lot of science involved in the process.
- Smallest of mistakes in the process can have a major impact on the final product. Basically, wine is made in 5 different steps.

  - Step 1 – Harvesting
  - Step 2 – Crushing
  - Step 3 – Fermentation
  - Step 4 – Clarification
  - Step 5 – Aging and Bottling

Harvesting

- The moment at which the grapes are picked from the vineyard is what actually determines the sweetness, flavour and acidity of the wine.
- Fresh and fully ripened wine grapes are preferred as raw material for wine making.
- In cool climates, as in northern Europe and the eastern United States, however, lack of sufficient heat to produce ripening may necessitate harvesting the grapes before they reach full maturity.
- The resulting sugar deficiency may be corrected by direct addition of sugar or by the addition of a grape juice concentrate.
- Because of the effect upon grape composition, proper timing of the harvest is of great importance.
- Premature harvesting results in thin, low-alcohol wines; very late harvesting may yield high-alcohol, low-acid wines.
- Harvesting can be done by hand or by machines.
- Once pipked grapes are taken to winery and are then sorted in bunches.
- Under ripe and rotten grapes are removed.

Crushing

- There are mechanical presses available which trod or stomp the grapes into ‘must’.
- Must is nothing but fresh grape juice which is the outcome of the crushing process and contains seeds, solids and skins of the grapes.
- In modern mechanized wine production, the grapes are normally crushed and stemmed at the same time by a crusher-stemmer.
- A roller-crusher may also be used.
- If white wine is being made then the seeds, solids and skins are quickly separated from the grape juice to prevent the tannins and color for leaching in the wine.
- On the other hand, if red wine is being made, the seeds, solids and skins are allowed to stay in contact with the juice to allow the juice to get additional tannins, flavour and colour.
- The drained pomace (crushed mass remaining after extraction of the juice from the grapes), from white or red fermentations, may be used to provide distilling material for production of wine spirits.

Fermentation

Pretreatments of Must

- Wines can be created by using the natural grape skin microorganisms.
- This natural mixture of bacteria and yeasts gives unpredictable fermentation results.
- To avoid such problems, one can treat the fresh must with a sulfur dioxide fumigant to kill the wild yeasts and bacteria or sometimes pasteurized to destroy the natural microbiota.
- White musts are often turbid and cloudy, and settling is desirable to allow separation of the suspended materials.
- Such measures as prior addition of sulfur dioxide and lowering of the temperature during settling help prevent fermentation and allow the suspended material to settle normally.
- In many areas wineries centrifuge the white must to remove the solids.
- Musts are sometimes pasteurized, inactivating undesirable enzymes that cause browning.
- There is renewed interest in the prefermentation heat treatment of red musts to extract colour and deactivate enzymes.

Fermentation

- Must now flows either into a stainless steel fermentation tank or a wooden vat (for fine wines).
- Must then inoculated with a desired strain of *Saccharomyces cerevisiae* or *S. ellipsoideus.*
- Depending on alcohol tolerance of the yeast strain, final product may contain 10 to 18% alcohol.

Primary Fermentation

- After 8-10 hours from inoculation with yeast the primary, alcoholic fermentation starts.
- This fermentation generally lasts for 8-10 days and during this period the yeast cells utilise the sugars in the must and multiply, producing carbon dioxide gas and alcohol.
- The temperature used for red wines is typically 25° to 28 °C while for white wines it is 20° to 25 °C.
- During fermentation it is important to control the temperature and the oxygen concentration of the must.
- During alcoholic fermentation other substances (minor products): glycerol, acetic acid, higher alcohols, and acetaldehyde are also produced.
- Wine quality is also defined by the quantity of these compounds and particularly by low concentrations of acetic acid, higher alcohols and acetaldehyde.
- In the must used for red wine production, skins and seeds are present and during the alcoholic fermentation the colour and tannin must be extracted.

...Primary Fermentation

- Seeds fall to the bottom of the tank while skins are pushed to the top of the tank by carbon dioxide (know as "cap of pomace“).
- Grape skins are richer in flavour and colour (anthocyanin pigments) compounds and contact of the skin with the must allows flavour and colour extraction.
- To extract the colour and tannin in the skins, this cap must be broken and the fermenting must is thoroughly mixed several times a day.
- When the sugar concentration of the must has reached about 10 g/L or less, usually in 7-10 days, the must is drawn off the pomace.
- In some cases the wine may be allowed to remain with the skins and the seeds for seven or more days after the fermentation is complete in order to obtain wines with a high tannin concentration.
- Pomace and wine are generally separated using either vertical or horizontal presses.
- The wine is then placed in a storage tank where the alcoholic fermentation runs to completion.
- This process requires about a week.

...Primary Fermentation

- A critical part of wine making involves the choice of whether to produce a dry (no remaining free sugar) or a sweeter (varying amounts of free sugar) wine.
- This can be controlled by regulating the initial must sugar concentration.
- With higher levels of sugar, alcohol will accumulate and inhibit the fermentation before the sugar can be completely used, thus producing a sweeter wine.
- During final fermentation in the aging process, flavoring compounds accumulate and influence the bouquet of the wine.

Malolactic Fermentation

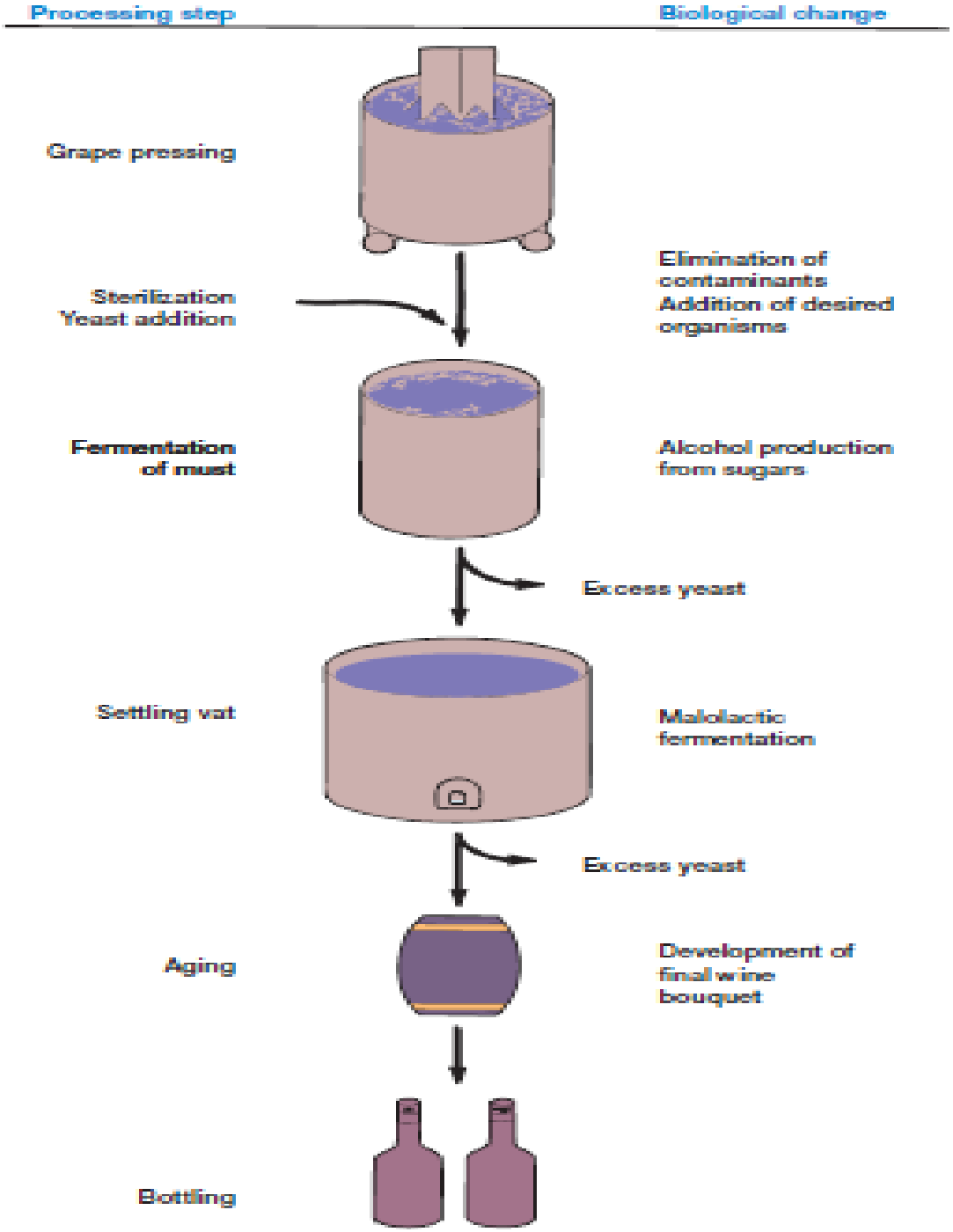
- When the sugar is fully utilised, the malolactic fermentation can take place.
- This process is used mainly for red wines but also for some white wines.
- In this process specific strains of the bacterium, *Oenococcus oeni,* convert malic acid to lactic acid.
- The fermentation reduces the titratable acidity and raises the pH which is advantageous in some wines.
- This fermentation is often initiated by inoculation with desired bacteria but can only be performed if the pH is higher than 3.2 and the temperature is higher than 20 °C.
- Malolactic fermentation is performed for 2-4 week then the wine is transferred to other tanks for final wine processing activities (fining, filtration, and aging).

Clarification

- The purpose of fining is to remove excessive levels of certain wine components, to achieve clarity and to make that clarity stable especially from a physicochemical viewpoint.
- Examples of such fining reactions are:
  - the removal of tannic and/or brown polymeric phenols by protein-fining agents such as casein, albumin or gelatin;
  - the adsorption of wine proteins by clays such as the bentonites and the elimination of unpleasant odors by copper sulfate.
- Filtration in winemaking is a general operation which encompasses a wide range of conditions from the partial removal of large suspended solids to the complete retention of microbes by perpendicular flow polymeric membranes.
- Microbial growth during the fermentation process produces sediments, which are removed during **racking.**
- **Racking can be** carried out at the time the fermented wine is transferred to bottles or casks for aging or even after the wine is placed in bottles.
- Generally all wines are subjected to fining and/or filtration processes but only some wines containing high concentrations of ethanol and tannins are selected for aging.

Aging and Bottling

- In general aging is used for red wines but some white wines (e.g. Chardonnay) are also subjected to aging.
- Aging is a very complex process which has many effects on the wine.
- It can be performed in two stages, bulk and/or bottle.
- Bulk storage can be performed with inert containers like stainless steel or white oak barrels (like French "barriques").
- In the latter case, however, the container reacts with wine; these reactions are more intense when small barrels are used.
- The most important reactions that occur during aging in an oak barrel are: wine oxidation, evaporation of volatile components and reaction between wine and oak components.
- The aging period can range from few months to many years and is dependent on the wine type.
- At the end of this period wine is generally only filtered and bottled.
- Aging in the bottle ranges from some days to many years and is dependent on wine type.


Processing step
Biological change
Grape pressing
Sterilization
Yeast addition
Elimination of contaminants
Addition of desired organisms
Fermentation of must
Alcohol production from sugars
Excess yeast
Settling vat
Malolactic fermentation
Excess yeast
Aging
Development of final wine bouquet
Bottling

Other Wines

- Many processing variations can be used during wine production.
- The wine can be distilled to make a “burned wine” or brandy.
- *Acetobacter* and *Gluconobacter* can be allowed to oxidize the ethanol to acetic acid and form a wine vinegar.
- Natural champagnes are produced by continuing the fermentation in bottles to produce a naturally sparkling wine.
- Sediments that remain are collected in the necks of inverted champagne bottles after the bottles have been carefully turned.
- The necks of the bottles are then frozen and the corks removed to disgorge the accumulated sediments.
- The bottles are refilled with clear champagne from another disgorged bottle, and the product is ready for final packaging and labeling.

Questions

- Write an essay on vinification.
- Discuss fermentation process of wine production.
- Write a short note on malolactic fermentation.