Unit IV - Topic 6
Wine – types and nutritional value

Wine

- Wine is a kind of undistilled alcoholic beverage mainly prepared from fruit juice. (mainly from grapes).
- The process of preparation of wine is known as **vinification** and the branch of science that deals with study of wine is known as **enology** (American) or oenology (British).
- There are different types of wine on different basis.
- Besides fruit and berries, non-toxic plants (flowers) etc can also be used for wine production.
- Since, basic constituent of wine is alcohol, other substrates are also added in it.
- It contains 3-22% of alcohol.

Color	Red(pigmented) White (not pigmented)
Sugar content	Sweet wine – some sugars are left during fermentation and recovery Dry wine- all sugars fermented into alcohol
Alcohol content	Table wine- 3-10% alcohol Fortified wine- 19-22% alcohol (since yeast cannot accumulate late alcohol, whisky is added) Dessert wine = Fortified sweet wine with 22% alcohol
Carbonation or CO_2 content	Still wine: no CO_2 is produced during fermentation. Sparkling wine: with CO_2 production. E.g. champagne

Wine production:

- Wine is basically the transformation of sugars of grapes of yeast under anaerobic condition into ethanol, CO_2 and small amounts of byproducts such as D-glucose.

What are the basic steps of wine making?

- **Step I: Harvesting of fruits:**
  - Appropriate variety of fruits and berries are harvested.
  - They must contain high amount of fermentable sugars.
  - Grapes usually contain 5-25% total soluble sugar (Total soluble sugar).
- **Step II: Crushing and extraction:**
  - Thus, obtained fruits are crushed and extracted mechanically.
  - This process releases juice and a little bit pigment.
  - The whole mass is known as Must.
  - For white wine preparation, the skin is removed. The harvested fruits are de-steamed for white wine preparation which is not required for red wine preparation.

- In case of red wine, the steam gives vegetable aroma due to presence of 2 methoxy-3-isopropyl pyrazine.
- Color is also extracted from steam.
- In case of red wine, the Must should be fermented.

- **Step III: Optimization:**
  - The must is optimized for two parameters, TSS and pH.
  - The TSS is generally optimized between 17-22% and pH in between 3-4, depending on yeast strains to be used.
  - KNS (potassium metabisulphite) may or may not be added at this stage which is an antimicrobial compound against *Acetobacter* spp. and competitive yeast.
  - It also acts as anti-oxidant and antifungal agent.
- **Step IV: Primary fermentation:**
  - The optimized Must is inoculated with 2-10% of inoculum and fermentation is carried out under optimum temperature.
  - Red wine preparation= 22-27^{o}C for 3-5 days
  - White wine preparation= 10-21^{o}C for 7-14 days
  - During the fermentation, the content is mixed twice a day by punching the floating skin for proper aeration.
  - It also helps in color extraction.
  - This fermentation allows rapid multiplication of yeast cell as well as sugar fermentation to ethanol, when the TSS is decreased nearly about 9-10% then primary fermentation is terminated.
- **Step V: Pressing:**
  - The skin of must is taken out and pressed in order to release juice and alcohol.
  - The liquid is again transferred into tank.
  - In case of white wine, pressing is carried out before fermentation.
  - During pressing color of fruits and berries is extracted.
- **Step VI: Heat and cold sterilization:**
  - The main aim of this technique is to remove the tartarate crystals (wine diamonds or wine crystals).
  - In cold sterilization method, the fermented must is cooled to nearly freezing and kept for one to two weeks.
  - During this period, the crystals gets separated or stirred in the wall of fermenter and clear liquid is collected on secondary fermented tank.
  - In heat stabilization technique, it is gently heated in between 50-60^{o}C for an hour and kept overnight.
  - The proteins get decanted.
  - The clear contents are pumped out and remaining turbid substance adsorbed on to bentonite.
- **Step VII: Secondary fermentation:**
  - It is carried out in stainless steel or oak barrel or concrete tank lined with plastic.

- The stabilized, sterilized wine is now kept at 15-20^{o}C for 3-6 months under strict anaerobic condition usually in case of sweet wine, the fermentation is terminated when sugar content is reduced to 4-6%.
- During secondary fermentation, aroma is developed.
- The aroma in wine is categorized into 3 types:
    - Primary aroma —-> contributed by fruits or berries
    - Secondary aroma ——> developed during secondary fermentation
    - Tertiary aroma ———-> developed during bottled ageing
- The aroma compound may be volatile or non-volatile.
- It is developed due to chemical reactions among acids (malic acid, citric acid etc), sugars, alcohols and phenolic compounds.
- The main compound responsible for aroma is methoxyparazine , monoterpenes, nor-isoprenoids, thiols, esters etc. among which ester is the principal one.
- Esters are produced by reaction between alcohols and acids which is very slow.
- It takes nearly one year for secondary fermentation
- Before secondary fermentation malo-lactic fermentation occurs.
- Malic acid (sharp sour) ——Lactic acid bacteria (LAB)—-> Lactic acid

- **Step VIII: Laboratory testing:**
    - After secondary fermentation, certain laboratory tests are conducted which includes bricks reading, bricks pH, titrable acidity, residual sugars, free or available sulfur, total sulfur, volatile acidity and alcohol percentage.
- **Step IX: Blending and fining:**
    - It is the most crucial to produce good quality of wine giving special taste and aroma.
    - In blending process, spices, extracts of aromatic plants, essential oils, fruit juices and other things are added in appropriate proportion.
    - Blending is kept trade secret in winery (wine industry).
    - In fining process, tannins and microscopic particles are removed in order to make clear wine.
    - For this purpose, wine is treated with gelatin, potassium caseinate, egg albumin, lysozymes, skimmed milk powder etc. or it is filtered through membrane filter or diatomaceous earth cellulose filter.
    - Finally, wine is clarified in order to remove pectin which is achieved with the use of pectinase enzyme.
- **Step X**: **Preservation:**
    - Pasteurization technique and use of KMS (Potassium metabisulphite) are mainly used for preservation.
    - It kills sugar utilizing micro-organisms.
- **Step XI: Bottling:**
    - Finally, wine is aseptically filled in bottle and bottle is corked, which is usually made with oak.
    - Finally, the outside cork is sealed.

- The bottled wine can be directly consumed or preserved.

Distillation of wine:

- These are the alcoholic beverages/drinks obtained by the distillation of wine or fermented cereals.
- It may be aged or unaged (i.e. the distilled liquor).
- Distilled liquor is commonly called spirits.
- They consist of more than 40% ethanol.
- There are various types of distilled liquor. The primary types are:
- Whisky (Barley and others) —-> aged
- Brandy (Wine distillation) ——> aged
- Rum (fermented molasses) ——> aged
- Vodka (fermented cereals) ——> not aged
- Gin (distillation of fermented cereals) ——> unaged but flavored

Types of wine

Made with Different Grapes

Fundamentally speaking, red wines are made with red grapes (Pinot Noir, Cabernet Sauvignon, etc.) and white wines are made with white grapes (Chardonnay, Pinot Grigio, etc). What's interesting, though, is that nearly all wines we find in the marketplace were originally made from one species of grape called Vitis vinifera. Ampelographers believe that the first *Vitis vinifera* grapes were black grapes (e.g. red wine grapes) and that a natural mutation created the first white grapes.

For example, Pinot Noir (a black grape), Pinot Gris (a pinkish-gray grape), and Pinot Blanc (a white grape) all share the same DNA!

Made Using Different Parts of the Grape

After the grapes are picked and head to the cellar for winemaking, different processes are used to make red wine versus to make white wine. One of the most important differences is that red wines are fermented *with* the grape skins and seeds and white wines are not. This is because all the color in red wine comes from the skins and seeds of the grapes.

Made with Different Wine Making Methods

Red wines are loved for their soft, rich, and velvety flavors, whereas white wines are loved for their zesty acidity, floral aromas, and pure fruit notes. To achieve these results, winemakers enlist two very different methods of winemaking. The largest difference between red winemaking and white winemaking is the oxidation that causes the wines to lose their floral and fruit notes in exchange for rich, nutty flavors and more smoothness. To increase oxygen, winemakers use oak barrels because they breathe and allow the wine to ingress oxygen. To reduce the exposure to oxygen, winemakers use stainless steel tanks, which ensures that wines retain their fruitiness and flower flavors.

Nutritional and health value of wine

part of the benefit might be that antioxidants in red wine may increase levels of high-density lipoprotein (HDL) cholesterol (the "good" cholesterol) and protect against cholesterol buildup.
Antioxidants in red wine called polyphenols may help protect the lining of blood vessels in the heart. A polyphenol called resveratrol is one substance in red wine that's received attention for its health benefits. Resveratrol might help prevent damage to blood vessels, reduce low-density lipoprotein (LDL) cholesterol (the "bad" cholesterol) and prevent blood clots.

However, studies on resveratrol are mixed. Some research shows that resveratrol could be linked to a lower risk of inflammation and blood clotting, which can lower the risk of heart disease. But other studies found no benefits from resveratrol in preventing heart disease.

Various studies have shown that moderate amounts of all types of alcohol benefit the heart, not just alcohol found in red wine. It's thought that alcohol:

- Raises HDL cholesterol (the "good" cholesterol)
- Reduces the formation of blood clots
- Helps prevent artery damage caused by high levels of LDL cholesterol (the "bad" cholesterol)
- May improve the function of the layer of cells that line the blood vessels