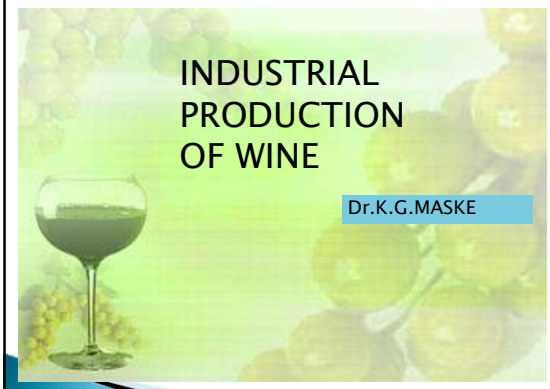

Wine

- 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.

Wine production:

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

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. **S.cerevisiae var ellipsoides**
- It also acts as anti-oxidant and antifungal agent.

- **Step IV: Primary fermentation: Wooden Tanks**
  - The optimized Must is inoculated with 2-10% of inoculum and fermentation is carried out under optimum temperature.
  - Red wine preparation= 22-27°C for 3-5 days
  - White wine preparation= 10-21°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.
- It is developed due to chemical reactions among acids (malic acid, citric acid etc), sugars, alcohols and phenolic compounds.
- 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 VII**: **Preservation:**
  - Pasteurization technique and use of KMS **(Potassium metabisulphite)** are mainly used for preservation.
  - It kills sugar utilizing micro-organisms.
- **Step VIII: 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.
- Reference:
- https://www.onlinebiologynotes.com/