



GRAPE WINE

Introduction

Grape wine is perhaps the most common fruit juice alcohol. Because of the commercialisation of the product for industry, the process is well known and documented.

The production of grape wine is quite straight forward and can be carried out at the small-scale, without the need for very expensive or specialised equipment. It does, however, require a basic understanding of the processes involved, tightly controlled fermentation conditions to ensure a high quality product and a strict adherence to cleanliness and hygiene to prevent contamination of the wine by spoilage bacteria.

Essentially, wine production involves the following basic steps;

- crushing the grapes to extract the juice
- alcoholic fermentation
- bulk storage and maturation of the wine in a cellar
- clarification and packaging.

There are really two distinctive types of wine made from grapes – red wine and white wine. The main difference in the two types is the variety of grape used as raw material and the removal of grape skins in the production of white wine. Grapes contain a number of chemical compounds that all contribute to the flavour and colour of wine. Tannins are one group of compounds that give the wine a bitterness and astringency. The tannins are found in the grape skins, therefore red wines tend to be more astringent than white wines.

Ingredients

Grapes
Sugar
Wine yeast
Boiled water

Equipment needed

Large plastic bucket with a lid
Thermometer
Fermentation vessel that can be closed with an air lock
Funnel
Syphon tube
Sterilising solution (sodium metabisulphite)
Wine bottles and corks
Corking machine
Hydrometer (optional)

Principles of wine making

Wine making uses the following basic principles:

- The sugars present in the fruit (and any sugar that is added to the fruit) are fermented by yeast that is added to the mixture. There are natural yeasts present on the skins of fruits, but these are usually not sufficient to carry out the fermentation on their own.
- When sugar is fermented by yeast, it is converted into alcohol (ethanol) and carbon dioxide gas is released. You will see bubbles of carbon dioxide gas in the air lock while

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the fermentation is active. You know the fermentation is over when no more gas is produced.

- The fermentation has to take place without oxygen (it is an anaerobic fermentation). If oxygen gets into the system during the fermentation, the alcohol will be converted into acid (this is what happens when you make vinegar, which is acetic acid). Wine that has spoiled because it has been exposed to the air may taste very acidic.
- There are lots of bacteria and yeasts around in the air and on the surface of the fruits. They all have the potential to spoil the wine. It is extremely important that these bacteria do not start to grow in the fermenting grape juice. Particular care must be taken with the cleanliness of the equipment and personal hygiene.
- All equipment must be sterilised with a solution of sodium or potassium metabisulphite before it is used.

Production of red grape wine

Red grape wine is an alcoholic fruit drink of between 10 and 14% alcoholic strength that is made from the fruit of the grape plant (*Vitis vinifera*). The colour ranges from a light red to a deep dark red depending on the grape variety and the length of fermentation and maturation. There are many varieties of grape used including *Cabernet Sauvignon*, *Grenache*, *Nebbiolo*, *Pinot Noir*, and *Torrontes*. The skins of the grape are included in the production of red wine, to allow for the extraction of colour and tannins, which contribute to the flavour.

Production of white grape wine

White grape wine is an alcoholic fruit drink of between 10 and 14% alcoholic strength that is made from the fruit of the grape plant (*Vitis vinifera*). The grape varieties used for making white wine include the following: *Airen*, *Chardonnay*, *Palomino*, *Sauvignon Blanc* and *Ugni Blanc*. White wine has a pale yellow colour. The skins are removed from the grapes before fermentation begins.

The fermentation process is very similar for both types of wine:

Raw material preparation

Select healthy, ripe, undamaged grapes. The fruit should taste sweet, ripe and slightly tart. Make sure they are ripe by squashing two handfuls, straining the juice and measuring the sugar level with a refractometer if you have one available. The total soluble sugars should be about 22° Brix, which is equivalent to a specific gravity of 1.0982 or 11% potential alcohol. Remove the grapes from the stems (stems make the wine taste bitter). Discard any that are rotten or unripe. Wash them well in clean water to remove dust. Crush the grapes to yield the juice plus skins, which is known as *must*. Traditionally grapes are crushed in large open vessels by people walking on them with bare feet. This really is not very hygienic and is not recommended. It is preferable to use a sterilised potato masher or very clean hands.

Sterilise the equipment

It is essential to sterilise all the equipment before use. Wash the equipment in boiling water. Use a solution of sodium or potassium metabisulphite to clean the fermentation vessel and the bottles for storage. Add 3 tablespoons of potassium metabisulphite to 4.5 litres of water and mix well. Rinse the bottles well with boiled water afterwards to get rid of any residual sulphite.

Processing

Red wine

Transfer the crushed grapes plus skins to a large fermentation vessel, such as a plastic bucket with a lid. Seal the lid, place in a warm room (21-24°C) and leave to ferment for between 24 hours and three weeks. The ethanol produced during this initial fermentation helps with the extraction of pigment from the skins. The longer the fermentation, the darker the wine.

Remove the skins and transfer the partially fermented wine to a separate tank to complete the fermentation. Add yeast to the fermenting grape must, close the top of the fermentation vessel with an airlock that contains water, place in a warm place (21-24°C) and leave to ferment until all the sugar has been converted to alcohol or the alcohol content of the wine has reached a high enough level. You know this has happened when the bubbles stop appearing in the water in the air lock. You can measure the specific gravity of the wine with a hydrometer. This gives an indication of the amount of alcohol that is present.

White wine

Strain the extracted grape juice into a fermentation bucket. Add the wine yeast, seal the fermentation vessel and leave in a warm place (12-18°C) for 7 to 14 days to ferment. The low temperature and slow fermentation encourages the retention of volatile compounds which give the wine flavour.

Adjusting the Juice

Controlling the acidity, sugar content and temperature of the juice (must) are all critical to producing good quality wine.

The acid content can be measured using a titration kit. The ideal acid content is 6 to 7 grams per litre for dry reds and 6.5 to 7.5 grams per litre for dry whites. If the acidity is too low, add tartaric acid (in very small amounts) until the acidity reaches the desired level.

The sugar level should be about 22° Brix for both red and white wines. If it is lower than this, increase it by adding a sugar syrup to the juice. Make the sugar syrup by dissolving one cup sugar into one-third cup of water. Bring it to a boil in a saucepan and immediately remove from the heat. Cool before adding in small amounts, one tablespoon at a time, until the desired degrees Brix is reached. To lower the sugar level, simply dilute the must or juice with water.

The temperature of the must should be adjusted to provide optimum conditions for the yeast to grow. The optimum temperature of the juice is about 22-24°C for red wines and 12-18°C for white wines. If the juice is colder than this, warm it by gentle heating, but do not boil as this affects the flavour of the wine.

Racking the Wine

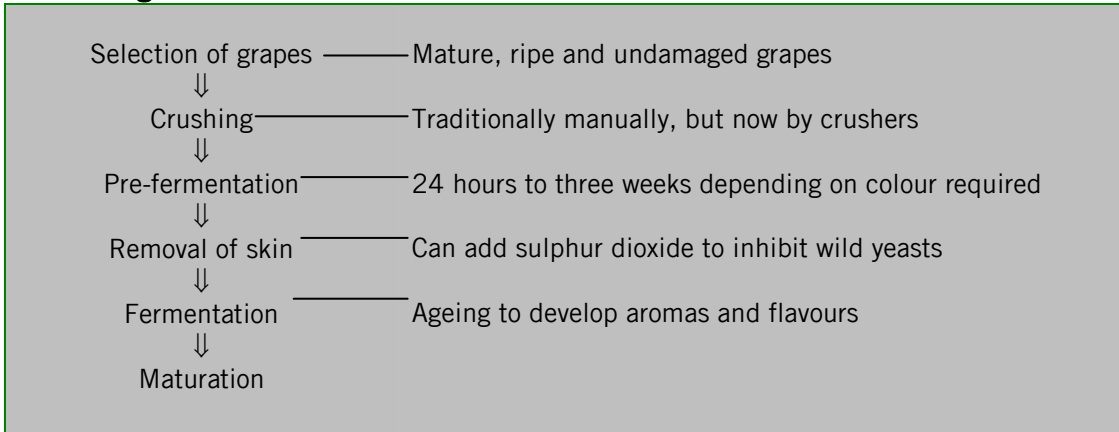
"Racking" means transferring the fermenting wine away from the sediment at the bottom of the bucket. Use a clear plastic tube to siphon off the wine into a sterilised fermentation jug. Do not disturb the sediment at the base of the bucket – it is important to have a clear wine without cloudiness or debris. Seal the top of the fermentation jug with a sterilised bung and a fermentation airlock. Leave to ferment until no more carbon dioxide gas can be seen escaping via the air lock (this means that all the available sugar has been converted into alcohol, or the yeast has died and the fermentation is complete).

Bottling the Batch

After fermentation, the wine is bottled by siphoning it off into clean, sterilised bottles. Do not fill the bottles to the top (leave about 5cm of head space) to allow room for fermentation in the bottle if it happens. Insert a cork into the bottle using a hand corking machine.

Some wines can be drunk immediately, however most develop distinctive flavours and aromas by leaving them to age for a while. The bottles should be laid on their sides during ageing to keep the cork wet. If the cork dries out, it may allow air into the wine, which causes it to oxidise and spoil.

Flow diagram



Dry Red Table Wine

Ingredients (for 4.5l of wine)

- 9kg ripe red grapes
- 1 campden tablet (or 0.33g of potassium metabisulphite powder)
- Tartaric acid, if necessary
- Granulated sugar, if necessary
- 1 packet wine yeast (like Prise de Mousse or Montrachet)

1. Harvest the grapes once they have reached 22-24 percent sugar (22- 24° Brix). Wash well to remove dust. Remove stalks.
2. Sanitize all equipment by washing well with a solution of potassium metabisulphite (3tbs per 4.5 litres of water). Place the grape clusters into a nylon straining bag and place the bag into the bottom of the food-grade bucket. Using very clean hands or a sterilised tool such as a potato masher, firmly crush the grapes inside the bag. Crush the campden tablet (or measure out 1 teaspoon of sulphite crystals) and sprinkle over the must in the nylon bag. This is to control the growth of natural yeasts and bacteria that may be present on the skins of the grapes. Cover the bucket with cheesecloth and let it sit for one hour.
3. Measure the temperature of the must. It should be between 22-24°C. Take a sample of the juice in the bucket and measure the level of acid with a titration kit. If it's not between 6- 7 grams per litre then adjust with tartaric acid.
4. Check the level of total sugars (° Brix or specific gravity) of the must. It should be about 22° Brix (1.0982 SG). If it is lower than this, add a little bit of sugar dissolved in water. If the °Brix is higher than this, dilute the must with boiled water until it is the correct concentration.
5. Dissolve the yeast in 500ml warm (27-30°C) water and let it stand until bubbly (it should take no more than 10 minutes). When it is bubbling, pour the yeast solution directly onto the must inside the nylon bag. Agitate the bag up and down a few times to mix the yeast. Cover the bucket with cheesecloth, set in a warm place (20-25°C) and check that fermentation has begun in at least 24 hours. Monitor the temperature and the progression of the fermentation regularly. It may be necessary to wrap a blanket around the fermenting bucket to maintain the optimum temperature for fermentation. Keep the skins under the juice at all times and mix twice daily.
6. Once the must has reached "dryness" (at least 0.5° Brix or 0.998 SG), lift the nylon straining bag out of the pail and squeeze any remaining liquid into the pail.
7. Cover the pail loosely and let the wine settle for 24 hours. Rack off the sediment into a sanitized 4.5litre jug, topping up with a little boiled, cooled water to entirely fill the container. Fit with a sterilised bung and fermentation lock. Keep the container topped with grape juice or any dry red wine of a similar style. After 10 days, rack the wine into another sanitized 4.5litre jug. Top up with dry red wine of a similar style.

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8. After six months, siphon the clarified, settled wine off the sediment and into clean, sanitized bottles. Cork with the hand-corker.
9. Store bottles in cool, dark place and wait at least six months before drinking.
10. Red wine is fermented with the pulp and skins. This "cap" will rise to the top, so you need to "punch it down" frequently with a sanitized utensil

Dry White Table Wine

Ingredients (for 4.5 litres)

9kg ripe white grapes
1 campden tablet (or 0.33g of potassium metabisulphite powder)
Tartaric acid, if necessary
Table sugar, if necessary
1 packet wine yeast (like Champagne or Montrachet)

1. Harvest grapes once they have reached 19 to 22 percent sugar (19-22° Brix). Sort the grapes, removing any mouldy clusters, insects, leaves or stems.
2. Place the grape clusters into the nylon straining bag and put into the bottom of the food-grade plastic bucket. Using very clean hands or a sterilised tool such as a potato masher, firmly crush up the grapes inside the nylon bag.
3. Crush the campden tablet (or measure out one teaspoon of sulphite crystals) and sprinkle over the crushed fruit in the bag. This is to control the growth of natural yeasts and bacteria that may be present on the skins of the grapes. Cover the bucket and bag with cheesecloth and let sit for one hour.
4. Lift the nylon straining bag out of the bucket and wring the bag to extract as much juice as possible. You should have about 4-5 litres of juice in the bucket.
5. Measure the temperature of the juice. It should be between 12-17°C. Adjust the temperature as necessary. Take a sample of the juice in the bucket and use a titration kit to measure the acid level. It should be between 6.5 and 7.5 grams per litre. If the acidity is lower than this, add small amounts of tartaric acid to increase the acidity. Check the acidity after each addition of tartaric acid.
6. Check the degrees Brix or specific gravity of the juice. If it isn't around 22° Brix (1.0982 SG) adjust accordingly.
7. Dissolve the packet of yeast in 500ml of warm water (27-30°C) and let it stand until bubbly (no more than 10 minutes). When it is bubbling, pour the yeast solution directly into the juice. Cover the bucket with cheesecloth, set in a cool place (12-18C) and check that fermentation has begun in at least 24 hours. Monitor the temperature and progression of fermentation at least once daily.
8. Once the must has reached dryness (at least 0.5 °Brix or 0.998 SG), rack the wine off the sediment into a sanitized 4.5litre jug, topping up with dry white wine of a similar style. Fit with a sterilised bung and fermentation lock. Keep the container topped up with white wine. Ensure that the fermentation lock always has sulphite solution in it. After 10 days, rack the wine into another sterilised 4.5litre jug. Top up with wine again.
9. After three months, siphon the clarified wine off the sediment and into clean, sterilised bottles and cork them.
10. Store bottles in a cool, dark place and wait at least three months before drinking.

Equipment suppliers

This is a selective list of suppliers of equipment and does not imply endorsement by Practical Action.

General suppliers of brewing equipment

Youngs Home Brew - Wholesale suppliers of brewing equipment
 Cross Street, Bradley
 Bilston. West Midlands
 WV14 8DL.
 United Kingdom
 Tel: + 44 (0) 1902 353352
 Fax: + 44 (0) 1902 354852
 Email: enquiries@youngshomebrew.co.uk
<http://www.youngshomebrew.co.uk/>

Brew it Yourself

Unit 4 Parkside, Potters Way,
 Temple Farm, Southend On Sea,
 Essex. SS2 5SJ.
 Tel: +44 (0) 1702 614422
 Email: orders@esuasion.co.uk
<http://www.brew-it-yourself.co.uk/>

Refractometers and pH meters

Fisher Scientific UK Ltd
 Bishop Meadow Road
 Loughborough
 LE11 5RG
 UK
 Tel: +44 1509 231166
 Fax: +44 1509 231893
 Email: fisher@fisher.co.uk
 Web: www.fisher.co.uk

International Ripening Company
 1185 Pnieridge Road
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 Virginia 23502-2095
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 Email: info@QAsupplies.com
 Web: www.qasupplies.com

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References and further reading

- [Fermented Fruits and Vegetables: A Global Perspective](#), FAO,1998
- [Vino de Frutas: Serie Procesamiento de Alimentos 6](#), ITDG Latin America, 1998
- [Fruit Processing](#), a selection of Practical Action Technical Briefs
- [Fruit Waste Utilisation](#), Practical Action Technical Brief
- [Juices and Drinks](#), a selection of Practical Action Technical Briefs
- [Principles and practices of small and medium-scale fruit juice processing](#). FAO Agricultural Services Bulletin 146, Food and Agriculture Organization of the United Nations (FAO), (2001).
- [Technical manual on small-scale processing of fruits and vegetables](#), Food and Agriculture

- Organization of the United Nations (FAO)
- [*Setting up and Running a Small Fruit or Vegetable Processing Enterprise: Opportunities in Food Processing*](#) CTA
- [*Starting a Small Food Processing Enterprise*](#) by Peter Fellows, Ernesto Franco & Walter Rios Practical Action Publishing/CTA 1996
- [*Small Scale Food Processing*](#) 2nd Ed. P Fellows & S Azam Ali, Practical Action Publishing, 2003
- [*Fruit and Vegetable Processing*](#) UNIFEM Practical Action Publishing, 1993
- *Elaboración de Vino: Proyecto San Martín, A. Puerta*, ITDG-Perú/CEPCO, 2000 (In Spanish)
- [*Toddy & Palm Wine*](#), Practical Action Technical Brief
- [*Home Wine Making*](#)

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